

# AMERICAN ENGINEER CAR BUILDER & RAILROAD JOURNAL.

JANUARY, 1898.

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## POWERFUL SIMPLE LOCOMOTIVES FOR THE GREAT NORTHERN RAILWAY.

Two locomotives of extraordinary power, weight and size have recently been delivered to the Great Northern Railway and through the courtesy of Mr. J. O. Pattee, Superintendent of Motive Power of the road, and the Brooks Locomotive Works, the builders, we are enabled to present illustrations and a description of the interesting details of the design. The importance of the subject renders it inadvisable to attempt to show all of the details in a single article; we select the boiler and the cylinders as the most important features and will reserve others for the following issue. We understand that these engines are to be used in specially exacting service on one of the heavy grade divisions of the road and that they were designed with special reference to the work on that grade. The design is one of the most interesting ever produced and it is sure to attract attention from railroad men the world over. These locomotives are the heaviest ever built, with the exception of combinations such as the Johnstone Mexican Central engines, built by the Rhode Island Locomotive Works, which are really two locomotives in one. The specially heavy engines for the St. Clair Tunnel and the Class "S" of the Erie are in many respects comparable with the new Great Northern type, and for reference we give some of their characteristics. The weights of the Erie engine are taken from the railway company's figures:

	St. Clair Tunnel.	Erie Class "S."	Great Northern.
Cylinders.....	23 by 28 inches	16 by 27 by 28 inches	21 by 34 inches
Boiler pressure.....	100 pounds	180 pounds	210 pounds
Boiler, diameter.....	74 inches	78 inches	78 inches
Driving-wheels.....	50 inches	56 inches	55 inches
Heating surface.....	2,352 square feet	2,470.9 square feet	3,290 square feet
Grate area.....	38.6 square feet	89.8 square feet	34 square feet
Weight on drivers.....	180,000 pounds	173,700 pounds	172,000 pounds
Total weight.....	180,000 pounds	200,550 pounds	212,750 pounds

Among the chief features to be mentioned, the first is the cylinders, which are 21 by 34 inches in size. The stroke is longer than ever before used in locomotive practice so far as we are able to learn. These cylinders demand an enormous steam-producing capacity, and this is furnished in the shape of a boiler of the Player patent, improved, conical connection, Belpaire type, having a total heating surface of 3,290 square feet, working under a pressure of 210 pounds per square inch. The diameter of the smallest ring of the boiler is 78 inches and the largest is 87½ inches. The firebox is above the frames and is 10 feet 4 inches long by 3 feet 4½ inches

wide, the depth at the front being 36½ inches and at the back 79 inches. The grate area is 34 square feet and the ratio between the heating surface and the grate area is 96 to 1. The tubes furnish 3,045 square feet of heating surface, and it is noted that they are 876 in number, the diameter being 2½ inches and the length 13 feet 10½ inches over the sheets.

These dimensions are accompanied by great weight, the total weight in working order being 212,750 pounds, of which 172,000 pounds are on the drivers and 40,750 pounds on the truck. The total weight of engine and tender is 308,750 pounds. The weight upon each driving wheel is 21,500 pounds and these wheels are 55 inches in diameter and of cast steel.

An interesting treatment of the valve problem would naturally be expected in connection with these cylinders and the high steam pressure. The valves are of the piston type and are balanced. We shall not do more at this time than to call attention to the very large exhaust port and to the arrangement of the valve, whereby it runs in hollow sleeves. The drawing shows the construction, and further comments will be made in regard to this construction. The piston-rods are hollow and extended. The chief general dimensions are given in the following table:

Gauge.....	1 foot 8½ inches
Simple or compound.....	Simple
Kind of fuel to be used.....	Bituminous coal
Weight on drivers.....	172,000 pounds
" truck wheels.....	40,750 pounds
" total, engine.....	212,750 pounds
" tender, loaded.....	36,000 pounds
" total, engine and tender.....	308,750 pounds
Wheel base, total, of engine.....	26 feet 3 inches
" driving.....	15 feet 10 inches
" total, engine and tender.....	54 feet 34 inches
Length over all, engine.....	51 feet 4 inches
" total, engine and tender.....	61 feet 1½ inches
Height, center of boiler above rail, of stack above rail.....	9 feet 5 inches
Heating surface, firebox.....	35 square feet
" tubes.....	3,045 square feet
" total.....	3,290 square feet
Grate area.....	34 square feet

## WHEELS AND JOURNALS.

Drivers, number.....	3
" diameter.....	55 inches
" material of centers.....	Cast steel
Truck wheel, diameter.....	30 inch centers cast steel spoke
Journals, driving axle, size.....	9 inches by 11 inches
" truck.....	5½ by 12 inches
Main crank pin, size.....	Main rod bearing, 6½ inches by 6¼ inches; coupling rod bearing, 7½ inches by 5 inches; wheel fit, 7¾ inches diameter by 7½ inches long

## CYLINDERS.

Cylinders.....	21 by 34 inches
Piston rod, diameter.....	4½ inches
Kind of piston rod packing.....	Jerome
Main rod, length center to center.....	8 feet 10 inches
Steam ports, length.....	18 inches
" width.....	1½ inches
Exhaust ports, length.....	50 inches
" width.....	9 inches
Bridge, width.....	6¾ inches

## VALVES.

Valves, kind of.....	Piston
" greatest travel.....	6½ inches
" outside lap.....	1½ inches
" inside lap or clearance.....	1½ inches
" lead in full gear.....	0
" constant or variable.....	Variable

## BOILER.

Boiler, type of.....	Player Patent Improved Conical Connection Belpaire
" steam working pressure.....	210 pounds
Boiler, material in barrel.....	Steel
" thickness of material in barrel.....	¾ and 1½ inches
" diameter outside, smallest.....	78 inches
" largest.....	87½ inches
Seams, kind of horizontal.....	Sextuple lap
" circumferential.....	Triple lap
Thickness of tube sheet.....	¾ inch
Crown sheet stayed with.....	Improved system direct stays
Dome, diameter.....	30 inches

## FIREBOX.

Firebox, type.....	Horizontal over frames
" length.....	10 feet 4 inches
" width.....	3 feet 4½ inches
" depth front.....	38½ inches
" back.....	79 inches
" material.....	Steel
" thickness of sheets.....	¾ inch
" brick arch.....	None
Mud ring, width, front, 4 inches; sides, 4 inches; back, 4 inches; thickness.....	4 inches; riveting, double
Water space at top, front.....	4 inches; sides, 7 inches; back, 5 inches
Grate, kind of.....	Cast iron rocking

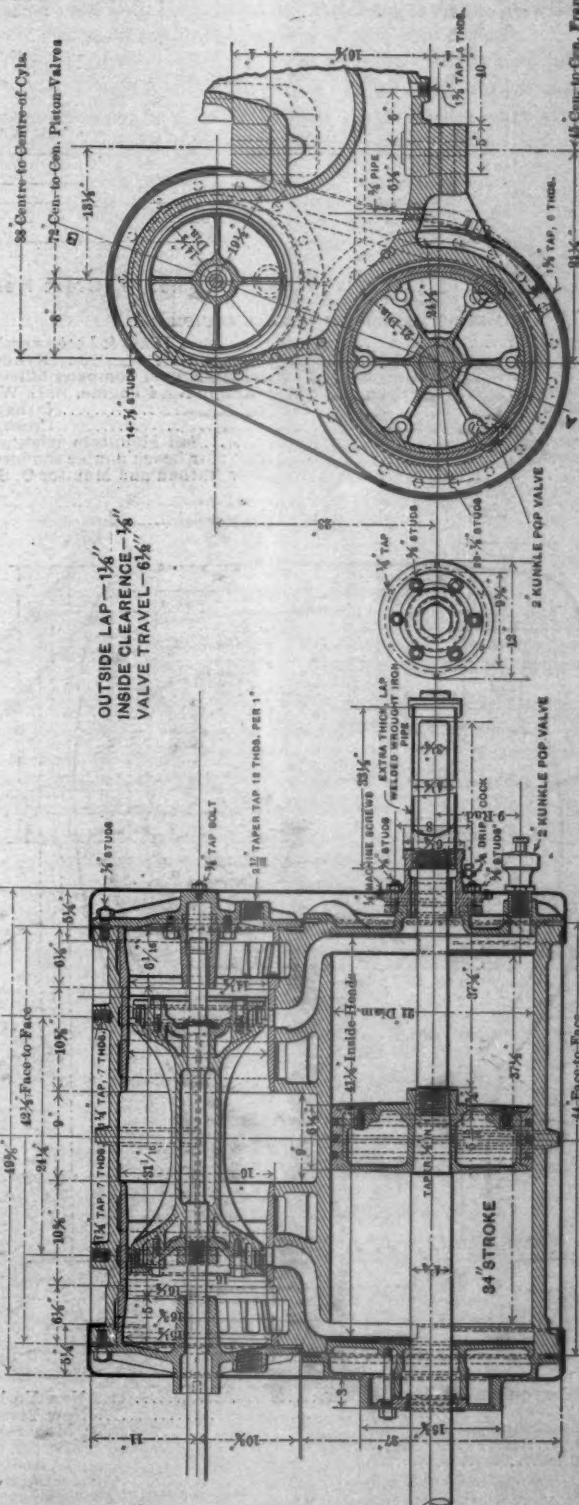
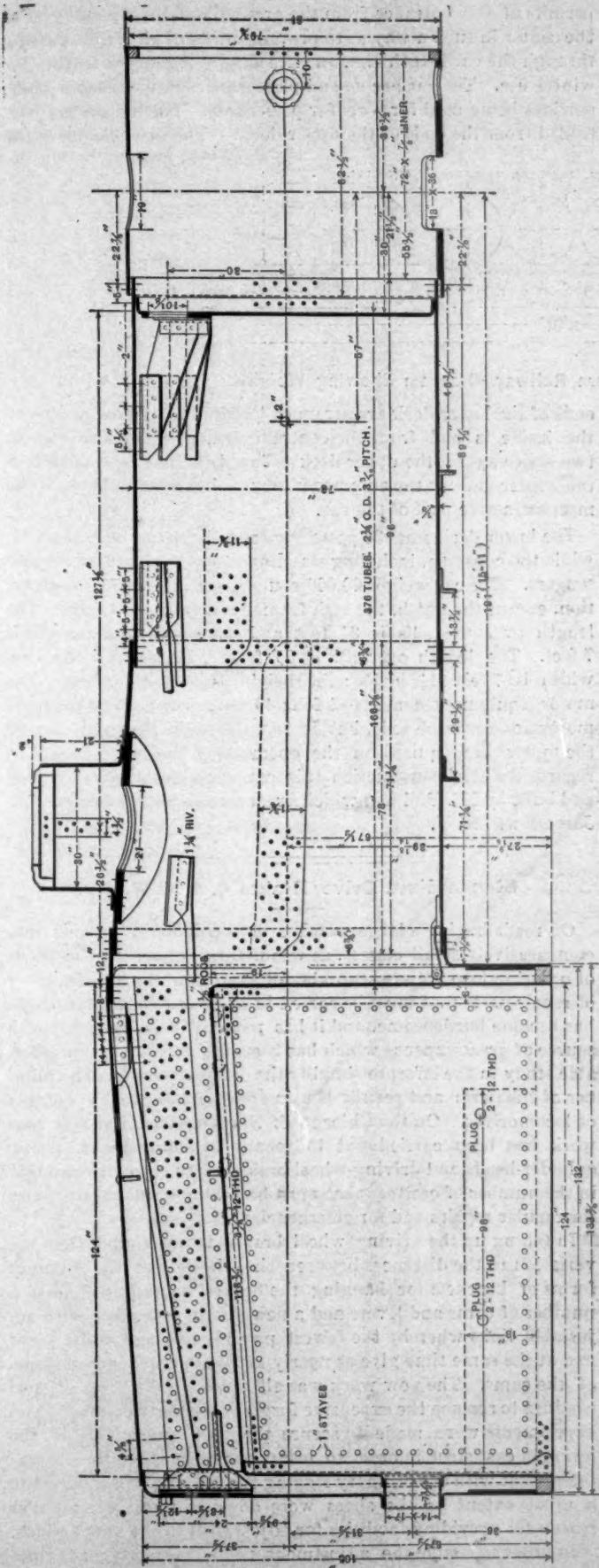
## TUBES.

Tubes, number.....	376
" material.....	Charcoal iron
" outside diameter.....	2½ inches
" length over sheets.....	13 feet 10½ inches



POWERFUL TWELVE-WHEEL SIMPLE LOCOMOTIVE FOR THE GREAT NORTHERN RAILWAY.

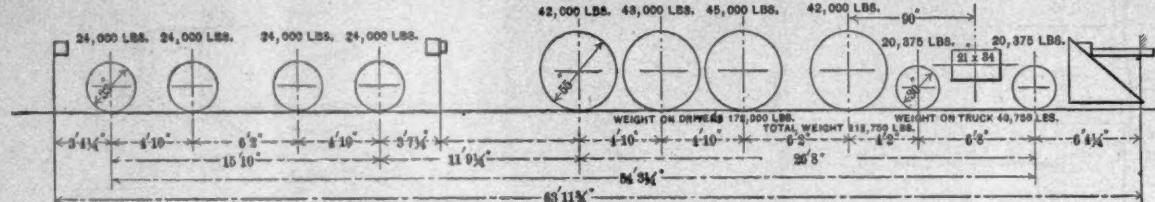
Mr. J. O. PATTEN, Superintendent of Motive Power.  
THE BROOKS LOCOMOTIVE WORKS, Builders.



**TWELVE-WHEELED LOCOMOTIVE GREAT NORTHERN RAILWAY—SECTIONS OF BOILER AND CYLINDERS.**

# AMERICAN ENGINEER, CAR BUILDER

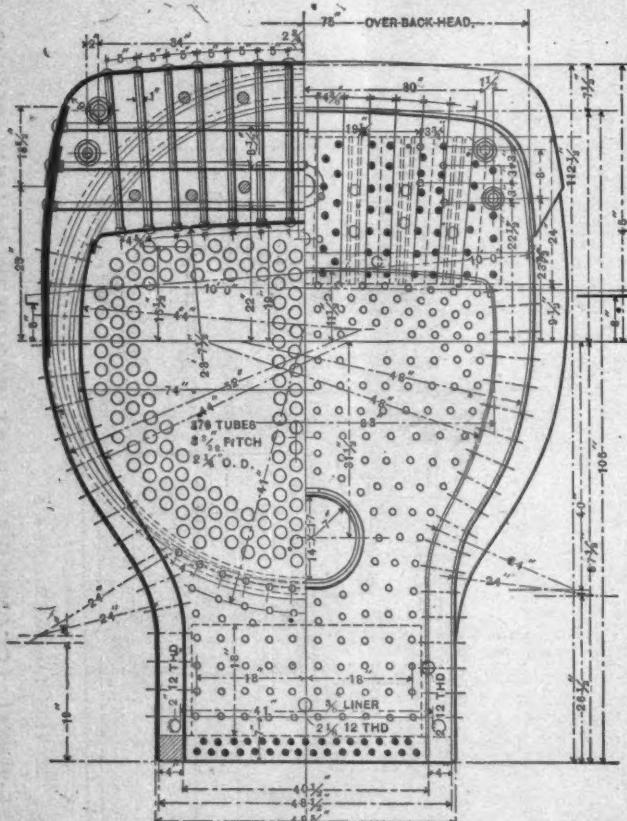
SMOKEBOX.	
Smokebox, diameter outside.....	81 inches
" length from flue sheet.....	67 inches
TENDER.	
Type.....	swivel trucks
Tank capacity for water.....	4,670 gallons
Coal capacity.....	10 tons
Thickness of tank sheets.....	$\frac{1}{8}$ inch and $\frac{1}{4}$ inch
Type of under frame, wood or iron.....	10-inch channel steel
Type of truck.....	Four-wheeled, Great Northern standard
Truck, with swinging motion or rigid bolster.....	Rigid
Type of truck spring.....	One-half elliptical
Diameter of truck wheels.....	33 inches
Diameter and length of axle journals.....	$4\frac{1}{4}$ inches by 8 inches
Distance between centers of journals.....	6 feet 3 inches



Twelve-Wheel Locomotive, Great Northern Railway—Diagram Showing Weights.

NAMES OF MAKERS OF SPECIAL EQUIPMENT.

Wheel centers.....	Pratt & Letloworth
Tires.....	Krupp
Axles.....	Pennsylvania Steel Company billets
Truck wheels.....	Tender, Krupp No. 4 engine, B. L. W.
Sight-feed lubricators.....	Nathan
Safety valves.....	Crosby
Boiler covering.....	Ball Mountain asbestos
Sanding device.....	One pair Leach double sanders
Injectors.....	New Nathan and Monitor O. S.



Section Through Firebox.

Driver brake equipment.....	New York
Tender ".....	New York
Tender brakebeam.....	Monarch
Air pump.....	New York No. 2
Steam gauges.....	Crosby
Whistle.....	Carron Chime
Headlight.....	Glazier Headlight Company
Springs.....	French
Metallic packing.....	Jerome

A Double Deck Steel Electric Car.

An interesting suburban electric car built of steel and having two decks for passengers has been built by the Wells & French Company to the order of the C. L. Pullman Car Company, of

Chicago. The car is to be used on the Chicago General Railway in its suburban service, the clearance being insufficient to permit its use on the downtown lines. This car is entered at the center by means of a low platform dropped between the trucks which permits of easy entrance from the ground, and divides the car at the center in such a way as to prevent drafts of air from passing through the car lengthwise, an exceedingly important feature for winter use. The car has no end platforms, but is enclosed, these portions being used for seats for passengers. The motors are controlled from the ends of the upper deck. The seats except at the

ends of the lower deck are arranged longitudinally and access to the inside is had from the central corridor, which also leads to two stairways for the upper deck. This deck may be enclosed in the winter and for the summer it may be left open, making it the most attractive part of the car.

The lower deck seats 36 passengers and the upper deck seats 44, while the capacity, including standing room, is placed at 200 passengers. The car weighs 20,000 pounds, and the entire construction, except the finish, the sash frames and rests, is of steel. The length over the sills is 34 feet and the width over the sills is 7 feet. The length over all is 35 feet 8 inches and the total width is 7 feet 11 1/4 inches; the height is 13 feet 6 inches. The motor equipment consists of four 40 horse-power Westinghouse motors, one on each axle, but it is understood that only two of the motors are required in the operation of the car. Except as regards the steel construction this car resembles those designed and built by Mr. Pullman which are running at Saratoga and at Jamestown, N. Y.

Standardized Driver Brakes C. & N. W. Ry.

On roads having a large number of locomotives divided into comparatively small classes, as was natural under the methods of ordering locomotives a number of years ago, the large number of repair parts that must be carried in stock for the various shops has become burdensome, and it has recently been seen to be a source of great expense which has been the subject of considerable study in the effort to simplify the designs, to reduce the number of the parts and permit of using one pattern for a number of locomotives. On the Chicago & Northwestern Railway this work has been carried out in regard to smokestacks, pilots, cylinder-heads and driving-wheel brakes to the great reduction in the number of castings that must be held in stock at all times for regular repairs and for emergencies.

In taking up the driving wheel brakes it was found that the variation in the distances between the wheels and the different forms of brackets for hanging the brakes necessitated quite a number of cams and levers and a new design was made with adjustable links whereby the fewest possible castings would serve and at the same time give as nearly as possible the correct shape of the cams. The new work was all made in the form of steel castings to replace the expensive forgings formerly employed and experiments were made to secure the best proportions of the levers in cast steel in order to insure sufficient strength. It was found that with the ordinary rigging the braking power varied to a great extent as the shoes wore down and this was another reason for providing facilities for adjustment in the new designs.

In order to enable the adjustment to be correctly made rules were prepared and tabulated to apply to all classes of engines. Fig. 1 shows the arrangement of the brake, and it will be noticed that the top ends of the shoes are held away from the wheels,



## Communications.

### Construction of Steel Cars.

EDITOR AMERICAN ENGINEER, CAR BUILDER AND RAILROAD JOURNAL:

I beg leave to thank you for your article on "The Passing of the Wooden Freight Car" in the December issue of your paper as I am eagerly watching for every item containing suggestions in regard to the design of cars in metal. This is the most important topic now before railroad men, at least I so regard it, and I hope you will do all that you can to present information and suggestions with regard to the best methods of construction. Almost nothing has been published about the best forms for the frames and the ways in which the steel car should be treated. I think steel cars are rapidly coming upon the scene and we are likely to make serious mistakes by attacking this problem by using old methods now in use in wooden cars, and I think we ought to branch out anew allowing present ideas as applied to wooden cars to pass along with the necessity for them.

To illustrate this, there seems to be a strong inclination to mix wood and steel in the car frames, which, I think, is all wrong. The upper frames will be of wood, but this part of the car is unimportant relatively to the underframe. My point is that we should start all over again in car construction, using only those ideas that belong to the wooden car that are clearly advantageous, and by attacking the problem from the side of the best construction as regards steel shapes we will find out that wood and steel will not mix and that what I will call "wooden ideas" ought not be used in steel underframing. I hope that I have made my meaning plain and if you will agitate this question of the best construction of steel cars, giving prominence to the underframe, you will do me and other interested people a great favor. The future car construction of large capacity cars will, I believe, follow lines of bridge work rather than those of our present practice.

BUILDER.

[We refer our correspondent to the article on steel cars, page 19, this issue.—ED.]

### De Laval's High-Pressure Steam Boiler.

An interesting steam boiler is working in connection with the De Laval steam turbines at the Stockholm Exposition. According to *Engineering*, the exhibit contained four turbo-generators of 66 units each and two boilers of 33 units each, connected with a high-pressure boiler. This plant was run during the greater portion of the day, yielding light and power to the whole of the Exhibition. The steam pressure was kept at 1,700 pounds per square inch.

The general arrangement of the boilers is quite novel, as they are worked automatically. The coals are stoked continuously from a box above the boiler; this box is filled once every two or three hours, according to the load of the turbine. The stoking boxes in the pavilion in the Exhibition were placed in the gallery. The grate is shaped like a ring, and has a revolving motion. The air necessary for the combustion is forced into the boiler by means of a fan coupled direct to the gearing shaft of the turbine. The steam pressure acts on the valves of the blast regulating the combustion, according to the quantity of steam consumed. The steam generator consists of several concentric spirals formed of solid drawn tube, tested under hydraulic pressure of more than double that of the working steam pressure. The feed water is forced continuously into one end of the boiler, and passes through the spirals one after the other with considerable velocity. The steam generated is submitted to superheating before passing to the turbine. There is no steam chamber or large recipient whatever in connection with the boiler; this would be impossible owing to the high pressure. The higher the steam pressure the smaller is the specific volume of the steam, and, consequently, the diameter of the tube can be kept small without involving any great loss in pressure from the velocity of the steam in the tubes. It is claimed that the danger of explosion is practically done away with in this system of boiler. In case a tube should actually burst, the steam in the broken part would immediately rush out, and as much steam would continue to do so as could pass through an opening equal to two sections of the tube—one at each end of the fracture—until the boiler had emptied itself of its contents. This quantity of steam is not greater than what can pass through the flues of the boiler into the smoke stack without causing any damage whatever.

The exceedingly powerful circulation of the water in the boiler naturally makes the heating surface very effective; this circumstance, coupled with the fact that the spaces for steam and water are very small, has made it possible to bring the dimensions of this new boiler within a small compass. A combination, for instance, of a 100 horse-power turbo-generator, with boiler and condenser, occupies only a floor space of 18.9 feet by 11 feet.

The exhaust steam from the turbine is condensed in a surface condenser; from this it is pumped into the hot-water receiver and then again fed into the boiler by the feed pump as in marine engines. By means of a special regulating apparatus the feed pump always feeds into the boiler as much water as the turbine consumes steam; by this arrangement the quantity of water and steam in the boiler, and at the same time the degree of superheat, are kept constant. At variable loads the fire and pressure of steam are regulated by the blast already referred to. The stoking is regulated automatically according to the rapidity of the combustion through the special construction of the revolving grate. The use of air blast has tended to considerably reduce the dimensions of the smokestack.

The De Laval boiler is self-contained requiring no brickwork except the foundation. The air supply passes through an outer shell, whereby it absorbs the radiant heat.

At the Stockholm Exhibition, the boilers, as already mentioned, worked at a pressure of 1,700 pounds, the temperature of the steam being about 600 degrees Fahr. The working parts of the De Laval turbine, it should be remembered, only come into contact with cool, expanded steam, by which arrangement very high degrees of superheat have been made practicable, which is synonymous with great economy of steam.

### Yellow Pine Car Lumber.

Yellow pine lumber is used to an increased extent in railroad work, and, says *The Timberman*, all through the season car builders have been making heavy demands, but there is no diminution as yet; and, in fact, the requirement promises to continue through the winter in unabated volume. The demands is not only from independent car shops, but from those which are owned by railroad companies; and is not only for car material but for construction purposes. Car shops are, almost without exception, filled up with orders, and are scouring the yellow pine country for sills, plates, siding, roofing, linings, etc. The Peninsular Car Company, of Detroit, Mich., is turning out its full capacity of 100 cars a day. The price of siding has advanced \$4 or \$5 within the last six months. Prices on sills and plates are higher than they were. The demand for yellow pine is increased by the adoption of this wood by some railroads which have not hitherto used it extensively. It is stated that the New York Central has requisitions out for 85,000 heart, yellow pine ties. The Pennsylvania Company is also going back to yellow pine, after having abandoned it for some time, and has recently placed orders in Georgia for 1,000,000 feet of car stock. Texas is a large buyer of railway material, chiefly ties, and altogether there is an amount of this kind of business which makes it a feature of the season.

### Warning to Inventors.

As the new amendments to the patent law go into effect on Jan. 1, 1898, it is well that inventors, both here and abroad, should bear in mind several of the very important changes which may seriously affect their rights.

1. Under the new law a patent cannot be obtained for any invention which has been patented or described in any printed publication in this or any other country more than two years prior to the application.

2. No patent shall be refused nor shall any patent be declared invalid by reason of its first having been patented in a foreign country, unless the said application was filed more than seven months prior to the application in this country.

3. The application must be completed and prepared for examination within one year after the filing of said application. In default thereof it shall be regarded as abandoned.

4. An interference will not be declared between an original application and a patent issued more than two years prior to the date of filing the said application.

In view of these changes in our patent practice, it is desirable that those who are interested and who will be affected by the laws as above mentioned should file their United States applications before Jan. 1.

It should at the same time be borne in mind that the term of the United States patent will not be shortened by the prior filing or issuing of a foreign patent for the same invention. It is possible, therefore, for the American inventor now to proceed with foreign applications without waiting for his United States patent to be issued.—*Scientific American*.

## New Laboratory Locomotive—Purdue University.

Much interesting and valuable experimental work has been carried out on the original Purdue laboratory locomotive, and in order to render it possible to keep the investigations "up to date," it was decided to replace the engine with a new one, which should be more nearly comparable with the most recent locomotive practice and should also render it possible to investigate compounding. For these reasons the new one, which we show in the accompanying illustrations, was recently built by the Schenectady Locomotive Works. The general features of the design were outlined by Prof. Wm. F. M. Goss, of Purdue University, and the details were arranged by the builders under the direction of Professor Goss. The total weight of the earlier engine, now designated as Schenectady No. 1, was 85,000 pounds, the cylinders were 16 by 24 inches, and the whole design was becoming out of date, while the greatest value of the data taken is for purposes of comparison with the results obtained in contemporary practice. One of the best features of the new engine is the "assorted sizes" of the cylinders, whereby questions which have never before been investigated may now be studied. The boiler

to fit the supporting rollers, but aside from this the engine might be mistaken for a new, light road engine. The cylinders are attached to the saddle after the old-fashioned method of casting them separate and bolting them in place; this makes it possible to change from a simple to a compound with very little trouble, and with two 20-inch and one 30-inch cylinder, together with a series of cylinder bushings, any combination of cylinders from 16 by 24 inches simple to 16 by 30 inches compound may be had with only three cylinder castings. With these variable proportions together with simple cylinders as large as 20 inches in diameter, the study of modern locomotive cylinder proportions should yield valuable results.

The boiler is of the extended wagon top type, the design and the form of riveted joints used being shown in the engravings. The staying is radial, with three rows of slings at the front. Our drawing shows the detail of the crown stays and the dome braces. The six central rows of crown stays have button heads. The pops are on a separate dome. The firebox is 72 inches long by 34 inches wide; it is between the frames and is of the same depth at both ends, 79 inches. The thickness of the crown sheet is  $\frac{1}{8}$  inch, the tube sheet is  $\frac{1}{8}$  and the back and side sheets are



Experimental Locomotive for Purdue University, Lafayette, Ind.

Built by the SCHENECTADY LOCOMOTIVE WORKS, Schenectady, N. Y.

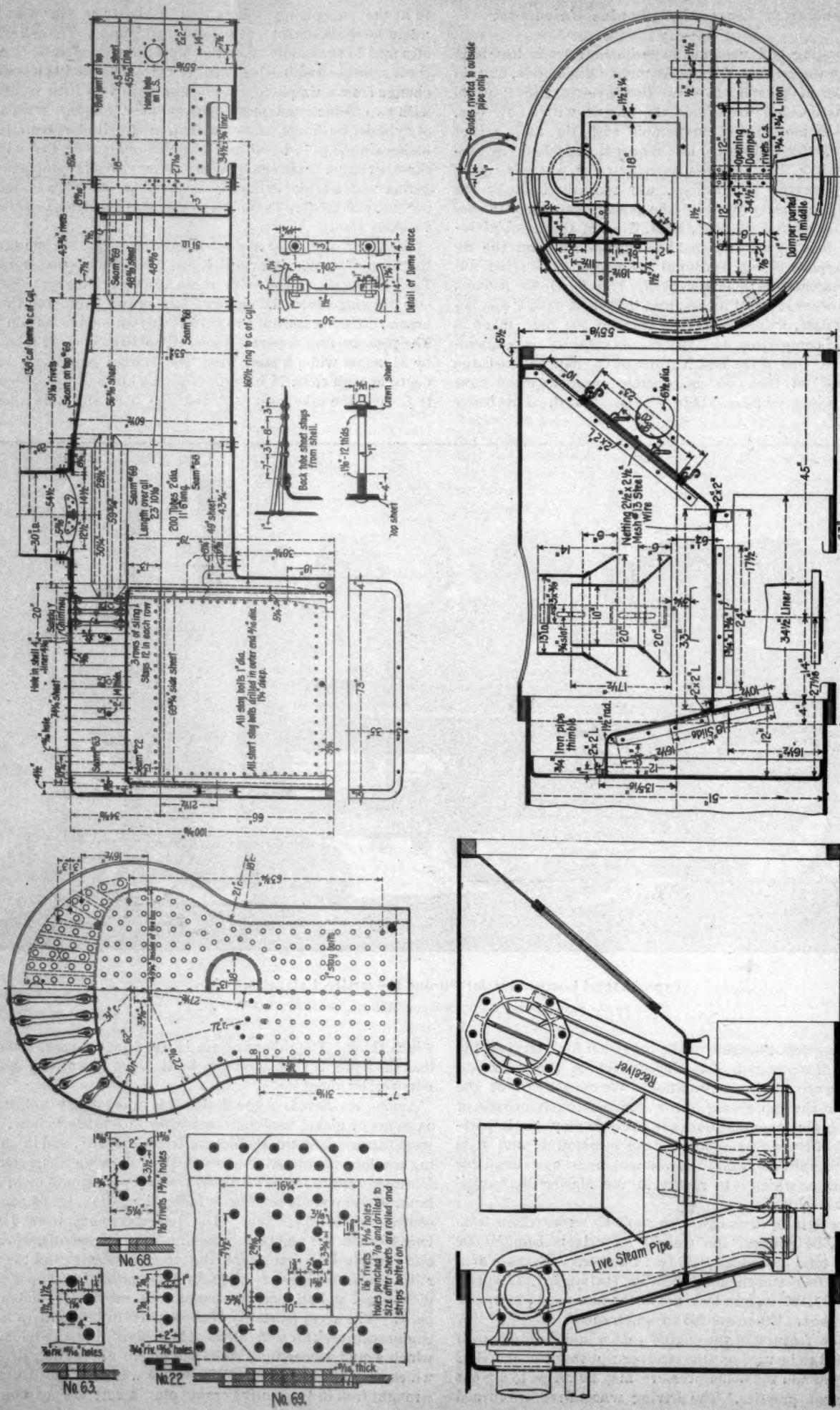
is an interesting detail because of the provision for carrying the high pressure of 250 pounds, and this should be the means of giving some very valuable information. We cannot forbear the suggestion that the appearance of the engine is timely in view of the fact that high steam pressures are likely to play an important part in the future development of the locomotive, and it is a cause for congratulation that the new engine is now available for the committee which is to report to the Master Mechanics' Association next June.

The total weight of the engine in working order (there is no tender) is 104,500 pounds, the weight on drivers being 64,000 pounds. The total wheelbase is 38 feet 6 inches. The grate area is 17.74 square feet and the total heating surface is 1,322 square feet, of which 1,195 square feet are in the tubes and 126 square feet in the firebox. There are 260 two-inch tubes.

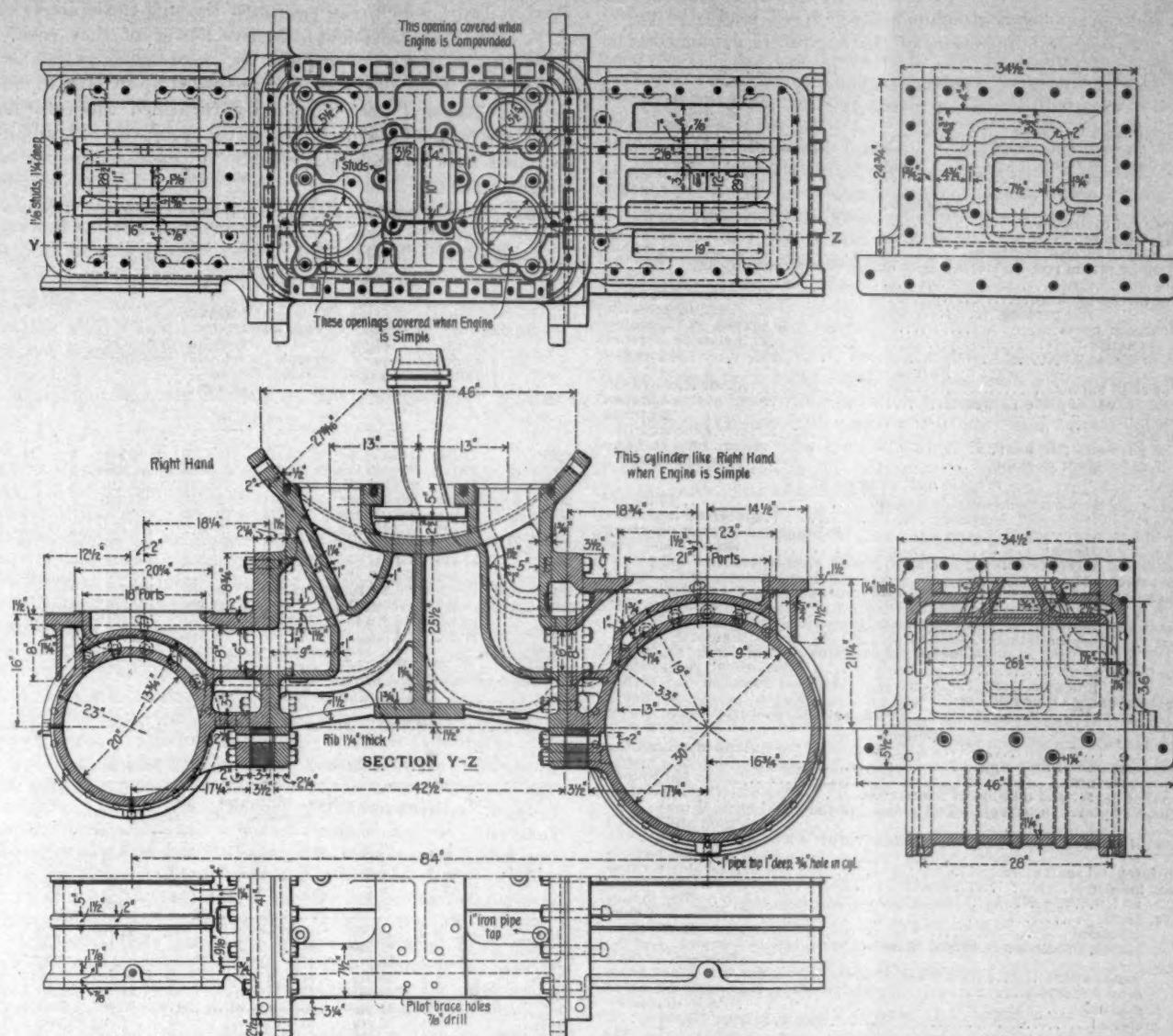
There are few features of the engine that would be different if it was intended to be used on the road except that the cylinders may be changed and the boiler pressure may be raised to a point far above present practice. The driving wheel tires are turned

$\frac{1}{8}$  inch thick. The tubes and are 11 feet 6 inches long, and except that the boiler is very strongly built there is nothing specially noteworthy about it.

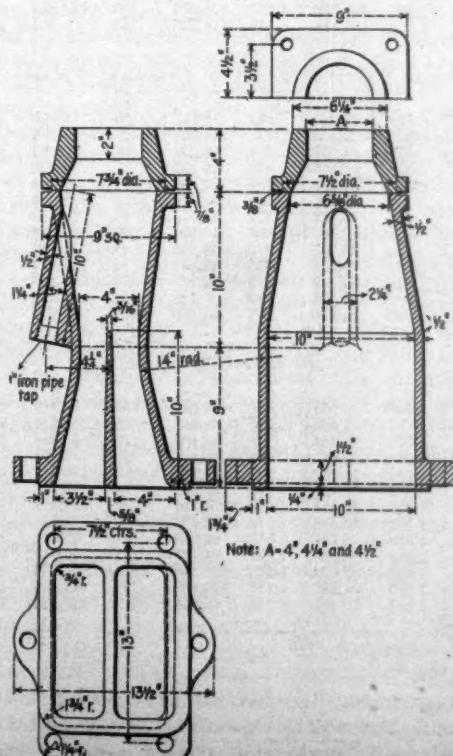
Among the details of the design it is interesting to note that the axles are of nickel steel and that they are made hollow. They were furnished by the Bethlehem Iron Company, and in the testing machine the material showed the following characteristics: Ultimate tensile strength, 91,000 pounds per square inch; elastic limit, 57,000 pounds per square inch; elongation, [25.05 per cent.; contraction, 56.45 per cent. The test specimens were 2] inches long between the points of measurement. These manufacturers also furnished the crank pins, the crossheads pins and the piston rods. These forgings are all of fluid-compressed acid open-hearth nickel steel and all but the piston rods are hollow and oil tempered. The great mortality of these parts in locomotives has led engineers to seek for some metal of high elastic limit and elongation which would successfully resist the severe alternating stresses to which they are subjected. When steel was first substituted for wrought iron in locomotive crank pins, a soft low carbon steel



## EXPERIMENTAL LOCOMOTIVE FOR PURDUE UNIVERSITY—ROLLER AND SMOKEBOX DETAILS



## **Experimental Locomotive for Purdue University—Plan and Sections of Cylinders.**



#### **Exhaust Nozzle Used with Simple Arrangement.**

was generally employed and failures due to "fatigue of metal" were almost as frequent as before. The broken pins showed what had been called "a fracture in detail," a gradual parting of the steel extending inward all around the piece, undoubtedly produced by the working strains repeatedly approaching the low elastic limit of the soft steel. On substituting a higher carbon steel with an elastic limit of 45,000 to 50,000 pounds per square inch, failures were greatly diminished without changing the diameter or shape of the pins. Steel of still higher elastic limit and proportionately greater elongation gives correspondingly better results and some of the representative railroads of the country are considering the adoption of, and others have already adopted, nickel steel wherever it can be used on their locomotives, and where the form and size of the forgings will allow of such treatment they are made hollow in order that they may be oil-tempered to still further increase the physical properties of the metal. The driving axle journals are  $7\frac{1}{2}$  inches in diameter and  $8\frac{1}{2}$  inches long. The driving boxes are of "stealed cast iron" and the bearings are of Ajax metal. The engine frames are composite, the tongues being of wrought iron and the main portions of cast steel.

An examination of the cylinder drawings will show that the low-pressure cylinder is secured to the frame by horizontal bolts passing through the cylinder walls, a practice that is becoming quite common in connection with large cylinders. When the engine is changed from simple to compound the receiver openings are closed, and the Master Mechanics' exhaust nozzle is used; this change is very easily made with the arrangements provided. We show the arrangement of the steam and receiver



average length of service would be 10 years and the average mileage would be 10 times the yearly mileage of the cars. As previously explained, this does not give accurate figures for any particular year, but it does give a correct method of comparison when a number of years are covered, and the statement shows the average mileage of all wheels taken out for all causes.

The average mileage for the past eight years is much larger than before that period, and there is a variation between 133,000 to 190,000 miles in the eight years. It has already been pointed out that between the years 1889 and 1890 there was a sudden jump in the figures, which is probably due to the introduction of the contracting chill which has been used for a large proportion of wheels cast since that time.

#### The American Society of Mechanical Engineers' Winter Meeting.

The first session of the meeting was called to order by the Secretary at 9 p. m. November 30, with the largest attendance in the history of the Society. The President, Mr. Worcester R. Warner, took for the subject of his address, "The Telescope Historically and Practically Considered," and illustrated it by lantern slides.

The address was an interesting and instructive presentation of the evolution of the present astronomical telescope from the earliest record, the influence of the engineer in its development being clearly brought out. It was the improvements in the manipulating mechanism whereby the observer might do accurate work in comfort, and those which permitted of the attachment of the camera to the telescope that enabled the astronomer of to-day to complete in 40 minutes observations that formerly required four years.

The Yerkes telescope was described in considerable detail, as it was the largest in existence, the objective being 40 inches in diameter, weighing 1,000 pounds. The tube was 62 feet long and weighed six tons, while the complete telescope weighed 70 tons. The clock for moving the telescope in following the movements of stars was obliged to move and keep in motion, a weight of 22 tons and in order to obtain satisfactory results the mechanism was required to be accurately made and provided with bearings having low fractional resistance. This movement was accomplished by a large clock acted upon by a weight of 850 pounds, falling at the rate of one and one-half feet per minute. This telescope and a large number of other typical ones, as well as the chief astronomical observatories, were shown on the screen. The paper was enjoyed and appreciated by the audience.

*Second Session.*—Annual Report of the Council. The chief features of this report were the usual financial statements, an amendment providing for the reception of candidates for membership who, by their location in foreign countries, might not have a sufficiently large acquaintance among the membership to enable them to secure the recommendation of five members. The report was adopted. It was announced that the standard oval decimal gauge had been patented by the Society in order to prevent improper use of it. It was stated that Messrs. Pratt & Whitney had been authorized to make the gauges under the patent and that other firms might secure the right to use it by making application.

The next business was the report by Mr. Gus Henning upon the meeting which he attended at Stockholm, where he represented the Society in the conference held to discuss the subject of uniform methods of testing materials. The report was interesting and it was evident that much progress had been made in the direction of international effort toward standardization. The reporter spoke of the great advantages to be gained by the use of standard specifications and showed that the cost of steel products would be materially reduced by their introduction and that the difficulties of inspection would be very much simplified. It was ordered that the council should appoint a committee to act with the American section of the international organization and to represent the Society in the movement.

The report of the tellers of the election was presented, showing that the following officers were elected:

President, Mr. C. W. Hunt; Treasurer, Mr. W. H. Wiley; Vice-Presidents, E. S. Cramp, S. T. Wellman, W. F. Durfee, John C. Kafer, David R. Fraser, Walter S. Russell; Managers, N. C. Stiles, E. D. Meier, G. W. Dickie, H. S. Haines, Gus C. Henning, A. W. Robinson, Jas. B. Stanwood, H. H. Supplee, George Richmond.

The report of the committee appointed to revise the standard code of rules for the conduct of boiler trials was then received. This report was explained by Mr. Kent to be a draft of a proposed

report rather than the report itself and the committee asked for the assistance of the members in the way of suggestions. A number of suggestions were made by members and the discussion was laid over until a later session.

A letter was then read from Mr. E. M. Herr suggesting the advisability of action on the part of the Society in regard to the work undertaken by the joint committee of the Master Mechanics' and the Master Car Builders' associations in regard to the standardization of pipe fittings. It will be remembered that Messrs. W. H. Marshall and C. H. Quereau are also members of that committee. The Society voted to submit the matter to a committee which should assist in this work. The importance of the subject was fully recognized by the Society.

The paper by Mr. F. W. Dean, entitled "Reduction in Cost of Steam Power from 1870 to 1897," was then read. We print extracts from it in this issue. It was full of valuable facts and awakened a somewhat animated discussion, which consisted largely in a defense of the water tube type of boiler. This defense was called forth by a statement by the author in the paper to the effect that the standard boiler of this country was the cylindrical type. We do not think the author suffered in the least in the discussion. The advantage of the reheater in steam-engine practice was called into question, but the author believed that when sufficiently high temperatures were used the advantage was marked.

The next subject was the paper by Mr. W. W. Christie, "Boiler Tests: Classification of Data and Plotted Results." It was a comparison of boilers by the results of numerous tests and concluded with a series of diagrams.

*Third Session.*—Prof. R. C. Carpenter's paper, "Test of Centrifugal Pump and Calibration of Weir at the Bridgeport Pumping Station, Chicago," was read. The pumps were described and the methods of the tests and the results were explained. Two pumps, one of the centrifugal and the other of undulating type, were tested; the first gave an efficiency of 54 per cent. when pumping 10,000 cubic feet of water per minute and the second gave an efficiency of only 41 per cent. under similar conditions. A weir was used for measuring the water. The author's experience showed him the advantages of building weirs so that they would have the minimum of end contraction. It was a case of a very large flow of water over a weir nearly 30 feet long, with means of checking the results, and was considered as establishing the Weisbach formula in place of that of Francis for these conditions. In view of the low efficiencies the paper clearly showed the importance of expert engineering advice in the selection and specification of pumping engines.

The next paper was by Mr. Howard Stillman, Engineer of Tests of the Southern Pacific Ry., entitled "A Water Purifying Plant." A very complete plant for the purification of feed-water for the use of locomotives was described, and the subject is of such interest that we reprint the paper in abstract in this issue. The discussion drifted somewhat from the paper, and brought out the fact that many of the members had used simple methods for the protection of their boilers, and of these methods the use of soda ash and electrical currents were mentioned. There were differences of opinion in regard to the efficacy of copper and zinc plates for the purpose of setting up electric currents in the boiler, but this plan had excellent support. It was thought to act in such a way as to prevent the crystallization of the precipitates in the boiler, the effect of which was to throw down mud instead of scale. Others called this process a humbug, but they did not present a strong case.

Dr. Thurston's paper, "Multiple Cylinder Engines: Effects of Variation of Proportions and Variable Loads," was then read by the author. This paper was an interesting record of experiments which tended to show that for certain conditions there was more to be gained in the use of compound engines of unusual proportions, a ratio of 7 to 1, than in the use of triple expansion engines. This subject was important, and we hope to find room for an abstract of the paper in a future issue. It was shown that it was possible to abandon the intermediate cylinder of the triple expansion engine in certain cases, not only without loss but with actual gain. The substance of the paper was expressed as follows: The unusual proportions of 7 to 1 in a compound engine approximated closely to the results from the triple engine at the most favorable expansion ratio for the triple.

Mr. Wm. S. Keep's paper on "Cast Iron Under Impact" was then read. The object of the paper was to record the results of an elaborate series of tests upon the effects of impact upon cast iron, including the effects of "tumbling" castings in a "tumbling barrel." The

result was to show that strength was increased by this action, but the effects considered quantitatively did not appear to be very uniform. The discussion was brief. The tests were not complete, but they show that:

Striking a test bar on the side or end decreases its length. Test bars tumbled in contact with other castings in a tumbling barrel increase in length. Tumbled test bars show large increase of strength. Blows delivered on the side or end of a test bar do not increase the strength. Test bars  $\frac{1}{2}$  inch square increase in strength until they have been tumbled two or three hours, but not materially by long tumbling. Of tumbled bars the weakest bars are most strengthened and the strongest bars are strengthened very little. The strength gained by tumbling is due to making the surface of the test bar smooth and to condensing the surface by peening. The removal of the surface weakens a test bar while smoothing the surface without removing it strengthens it. Smoothing the surface by pounding with a hammer increases the strength by condensing the grain. Test bars of gray iron containing least silicon gain most by the process of tumbling.

"Notes on Rating Electric Plants on the Heat Unit Standard," by Mr. W. S. Aldrich, was then read. This paper takes up in detail the subject introduced by the author at the previous meeting. The substance of this presentation was that the application of the same method of specifying the performance of electric power plants that had such a good effect upon the development of the pumping engine might be expected to work a similar improvement in the electric power plant.

*Fourth Session.*—The first paper was by Mr. J. B. Mayo, "A Strength of Gear Chart." The purpose of the paper was to record data with regard to the strength of gears in a form convenient for use in selecting gears for any special purpose. It was offered as a time saver. Mr. C. L. Griffin submitted written discussion, including another gear chart showing the load, pitch, width and factor of strength. He thought Mr. Mayo's chart covered too much.

The next paper was on "The Law of Hydraulic Obstruction in Closed Streams," by Mr. David Guelbaum. It had to do with the laws governing phenomena attending the obstruction of closed conduits and consisted of exhaustive mathematical treatment and included a formula.

The conclusion of the discussion on the report of the committee on revision of the code of rules for boiler tests was then opened by Mr. Charles E. Emery, who invited suggestions from the members. Professor Jacobus thought it very important to determine the amount of moisture in steam and illustrated a method in which three Barrus calorimeters were used, the samples being taken from nipples from the bottom and from different parts of the steam pipe, the area of the pipe being, in fact, explored for moisture. He thought that mercury instead of oil wells ought to be used for measuring superheating. Mr. Kent showed Professor Ringelmann's smoke scale, which was a new way of determining smoke by comparison with surfaces shaded in accordance with a formula. Water meters for measuring feed water were strongly condemned and actual weighing was endorsed. It was thought by several speakers that 10-hour tests must be inaccurate, 72 hours being thought necessary for the purpose of securing fair conditions.

Mr. C. J. H. Woodbury presented a report on the subject of electric wiring rules, which was adopted and will be printed in full in the proceedings.

*Fifth Session.*—This was opened by Mr. George W. Bissell's paper, "A Boiler Setting," which described a method of supporting a boiler from three points in such a way as to take care of expansion and contraction, and also to render the supports independent of the setting. No discussion.

Mr. George W. Dickie's paper, "Auxiliary Engine and Transmission of Power on Naval Vessels," was then read. An idea of the paper may be best obtained from the following quotation."

This paper does not aim to show the superiority of any one system over another, the comparisons made being simply to show that there is no mechanical difficulty in operating all auxiliaries by any one of the systems herein mentioned, and to express a hope that our government would either adopt some one system and carry it out complete, developing that system to its utmost efficiency, or else take one or two similar ships and fit them with power transmission systems completely representing different agents—say one electric, one hydraulic and one compressed air. Let each be placed for three years in the hands of officers heartily in favor of the system in use on their own ship, and thereby obtain a practical demonstration of the very best points in each system.

While we have hitherto advocated with all the ability we possess a complete hydraulic system, our experience in the practical working of hydraulics on shipboard has not been of the most pleasant character. Officers are required to care for and get the best out of a hydraulic system, while personally they would rather sit up all night with an electric plant than spend a moment more than the law requires with a water motor.

The future hopes of the young officer are centered in electricity, and he devotes himself to it with a will; and so long as that condi-

tion prevails, the electric method of transmission will have the best chance to succeed, because with that it has a flexibility and a general adaptability which the other systems do not in themselves possess.

In the discussion it was shown that while compressed air itself is safe, several air compressors had exploded on account of the vaporization of lubricating oil, but this might be avoided by water jacketing of the compressor cylinders.

Mr. H. M. Norris' paper, "An Accurate Cost Keeping System," contained the assertion that this subject precluded all forms of guesswork, which was the fundamental principle of cost keeping. The method devised by the author was described in detail, and included the forms of blanks used in determining the actual cost of each job of machinery work, including office and selling costs. The system involved monthly reports. In practice it had been very satisfactory. The discussion was lengthy, and treated the separation of the manufacturing and selling expenses and the general advantages of cost keeping. Mr. C. W. Hunt suggested that members interested should read the work by J. Slater Lewis, describing an English cost keeping system which was used very successfully in the speaker's works. The system permitted of balancing every month, and gave a satisfactorily accurate method for keeping track of the business. The clerical work was done by cheap labor, and required no thinking on the part of the clerks. A system that would show the cost of sharpening the President's skates was one member's way of describing a perfect system.

The next paper was "Thermodynamics Without the Calculus," by Mr. George Richmond. It presented the state of the art of a new method of treating thermodynamics without higher mathematics. The paper was intensely interesting and very valuable, but for the lack of time it was not discussed.

Mr. Chas. T. Main's paper on "The Valuation of Textile Manufacturing Property" was read. Its scope was well represented in the title.

Owing to the length of the earlier discussions the remaining papers were presented without much discussion. They were taken up as follows: "A Staybolt Threading Device and a Screw-die for the Turret Lathe," by Mr. Jas. Hartness; "Dustless Buildings," by Mr. C. J. H. Woodbury; "The Stevens Valve Gear for Marine Engines," by Mr. Andrew Fletcher; "Machine Moulding," by Mr. E. H. Mumford; "Electricity in Cotton Mills," by Mr. W. B. Smith-Whaley, and "A Convenient Form of Wire Testing Machine," by Mr. A. L. Rice.

The convention closed with a brief address by the President, Mr. Worcester R. Warner, who in a few well-chosen words expressed his gratification in the treatment that he had received and the assistance that had been given him by the officers and members.

It was announced that the next convention will be held at Niagara Falls, the date not yet being decided.

#### Locomotives for China—The Rogers Locomotive Company.

The Rogers Locomotive Company has completed and is now shipping eight mogul locomotives for the Imperial Government railways of China, these being for use on the Lu Han Railway. The gauge is standard, and with the exception of the six-wheel tender the design strongly resembles American practice. The following table contains a general description of the locomotives:

	General.
Gauge.....	4 feet $8\frac{1}{2}$ inches
Fuel.....	Bituminous coal
Weight on drivers.....	105,000 pounds
" truck wheels.....	20,500 pounds
Wheel base, total.....	125,500 pounds
" driving.....	22 feet 9 inches
" total (engine and tender).....	13 feet 9 inches
Height, center of boiler above rails.....	46 feet 11 inches
" of stack.....	8 feet 2 inches
Heating surface, firebox.....	14 feet 10 inches
" tubes.....	126.45 square feet
" total.....	1,503.35 square feet
Grate area .....	1,629.80 square feet
	24.2 square feet

	Wheels and Journals.
Drivers, number.....	6, of cast steel
" diameter.....	30 inches
Truck wheels, kind.....	Cast steel
" diameter.....	36 inches
Journals, driving axle, size.....	8 inches by 10 inches
" truck.....	5 $\frac{1}{2}$ inches by 12 inches
Axes, driving, material.....	Steel
" truck.....	Steel

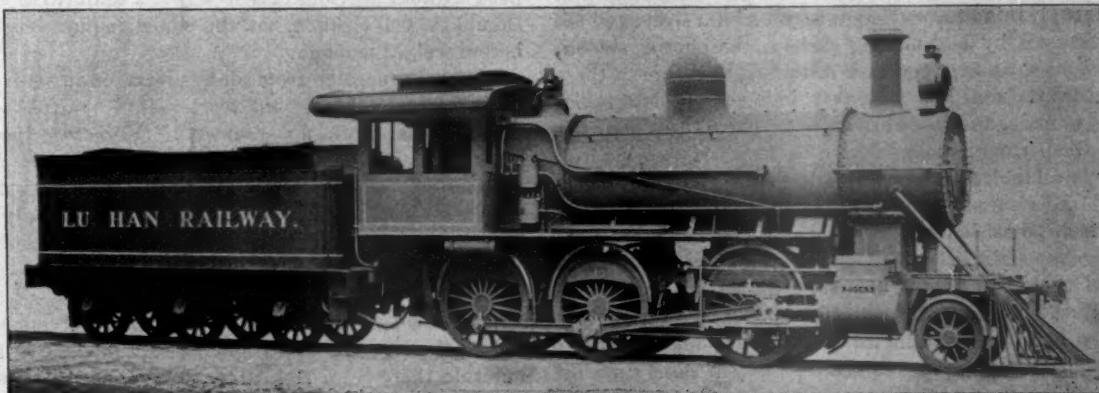
	Cylinders.
Cylinders, diameter.....	19 inches
Piston stroke.....	24 inches
" rod, diameter.....	3 $\frac{1}{4}$ inches
Kind of piston-rod packing.....	U. S. metallic

Main rod, length center to center.....	8 feet 9 inches
Steam ports, length.....	17 inches
width.....	15½ inches
Exhaust ports, length.....	17 inches
width.....	24 inches
Bridge, width.....	1¾ inches
Exhaust pipe.....	Single, high
Valves.	
Valves, kind of.....	Richardson
" greatest travel.....	.56 inches
" outside lap.....	.18 inch
" lead in full gear.....	.16 inch
Boiler.	
Boiler, type of.....	Belpaire
" working steam pressure.....	150 pounds
" material in barrel.....	Steel
" thickness of material in barrel.....	.75 inch
" diameter of barrel outside at first course.....	.00 inches
Seams, kind of horizontal.....	Sextuple riveted
" circumferential.....	Double riveted
Crown sheet stayed with.....	Radial stays
Dome, diameter.....	.30 inches
Tubes.	
Tubes, number.....	214
" material.....	Iron
" outside diameter.....	.2 inches
" length over sheets.....	13 feet 5 inches
Firebox.	
Firebox, length.....	7 feet
" width.....	3 feet 5½ inches
" depth front.....	.69½ inches
" back.....	.61½ inches
" material sides, back and crown.....	Copper, steel tube plate
" thickness of sheets.....	.16 inch
Grate, kind of.....	Supported on studs Rocking finger
Tender.	
Tank capacity.....	4,000 gallons
Coal ".....	7 tons

amounts the same extenders or fillers as the freight car color, and like it excludes barytes. The Tuscan red also contains as an essential constituent a percentage of organic coloring matter, usually what is known as chatemuc, or wood lake, or an alizarin lake. A minimum percentage of sesquioxide of iron being an essential feature of the specifications, a rapid and at the same time accurate method for its determination is desirable. The directions given below seem to secure this result.

#### OPERATION.

Remove the pigment from the six-ounce Erlenmeyer flask, in which it is left in the methods describing how to separate the pigment from the other constituents of freight and passenger car colors, previously published in these articles,\* by means of a spatula, taking care to get out all that can be so detached. The pigment, being received on smooth or glazed paper, is then mixed with the spatula, the lumps which are apt to be present being crushed in the operation. A uniform sample being obtained, weigh into a small porcelain crucible half a gram of the pigment, and ignite to destroy organic matter, avoiding very high temperatures. Put the ignited pigment into a two or three ounce beaker, and dissolve in hydrochloric acid, taking pains to clean the crucible by washing with some of the acid, and rubbing with a rubber tube on the end of a glass rod. Use in all 15 cubic centimeters of chemically pure hydrochloric acid, 1.10 specific gravity. In dissolving use heat; solution usually takes only a few minutes. In case of a refractory pigment, a few drops of the



Locomotive for China.—By the Rogers Locomotive Company.

Frame, type of.....	Steel plate 6-wheeled
Wheels, kind.....	Cast steel
" diameter.....	.42 inches
Axle, material.....	Steel
Journals, size.....	.54 × 10 inches

#### CONTRIBUTIONS TO PRACTICAL RAILROAD INFORMATION.

##### Chemistry Applied to Railroads—Second Series—Chemical Methods.

##### XXII.—Method of Determining Sesquioxide of Iron in Freight Car and Passenger Car Colors.

BY C. B. DUDLEY, CHEMIST, AND F. N. PEASE, ASSISTANT CHEMIST, OF THE PENNSYLVANIA RAILROAD.

##### EXPLANATORY.

The pigment of the standard freight car color is a mixture of sesquioxide of iron, with a little carbonate of calcium, and quite a large amount of various inert materials as extenders or fillers. These may include kaolin, gypsum, ground soapstone, silex, feldspar and asbestos or ground asbestos, as well as the natural impurities occurring in the iron ores, frequently used to furnish the required sesquioxide of iron. Barytes, or sulphate of barium, is excluded. The standard passenger car color, or Tuscan red, has likewise a basis of sesquioxide of iron, together with a small percentage of carbonate of calcium, and may contain in small

standard stannous chloride solution added from time to time greatly hastens solution; an excess should be avoided. When solution is complete, if stannous chloride has not been used, the solution will, of course, have the reddish color characteristic of ferric chloride. If stannous chloride has been used, even in very slight excess, the solution will be nearly colorless. The subsequent manipulation in the two cases differs. In the first case, while the liquid is still hot, add from a burette or pipette the standard stannous chloride drop by drop with agitation until the solution has lost the greenish yellow color, which is characteristic of the partially reduced solution. The smallest possible excess of stannous chloride should be present after reduction is complete. One drop after the color is gone will insure complete reduction. In case stannous chloride has been used to secure solution, add permanganate of potash solution, until the greenish yellow color characteristic of a partially reduced iron solution appears, and then add stannous chloride from a burette or pipette, until reduction is complete, as above described. Add now to the reduced solution five cubic centimeters of mercuric chloride solution, taking care to wash down the sides of the beaker containing the reduced solution with the mercuric chloride. Mix thoroughly and then pour the reduced solution into a beaker holding 500 cubic centimeters and containing 400 cubic centimeters of water, to

\* See this journal, Volume LXX., No. 4, page 51, and Volume LXXI., No. 9, page 301.

which has been added 10 cubic centimeters of phosphoric acid solution. Titrate now with standard permanganate, adding with moderate rapidity at first, then more slowly with constant stirring, until one drop gives the pink color characteristic of the end reaction.

#### APPARATUS AND REAGENTS.

The apparatus required by this method is simply the beakers, burettes, pipettes, etc., present in every laboratory, and requires no special comment.

The stannous chloride solution is made by adding to one pound of concentrated chemically pure hydrochloric acid one pound of chemically pure stannous chloride obtained in the market. Dissolve by stirring. If all the stannous chloride fails to dissolve after a little time, add enough water to secure solution. Dilute to two liters. The bottle holding this solution should be kept closed when not in use, and a few fragments of metallic tin added to keep the salt reduced to the stannous form.

The permanganate of potash solution for titration is made as follows: To one liter of water add two grams of crystallized permanganate of potash, and allow to stand in the dark not less than a week before using. Determine the value of this solution in terms of metallic iron. For this purpose 150 to 200 milligrams of iron wire or mild steel are dissolved in 15 cubic centimeters of chemically pure hydrochloric acid (1.10 specific gravity). After solution is complete, reduce with stannous chloride, add mercuric chloride, pour into solution of phosphoric acid, and titrate exactly as described above. It is of course essential that the amount of iron in the wire, or soft steel, should be known. The standard in use in the Pennsylvania Railroad laboratory is a mild steel in which the iron is known by determining carbon, phosphorus, silicon, sulphur, manganese and copper, and deducting the sum of these from 100 per cent. Not less than two independent determinations should be made, and three are better. The figures showing the value of the permanganate solution in terms of metallic iron should agree to a hundredth of a milligram in the different determinations. A very satisfactory method of making and keeping permanganate of potash solution is as follows: Have a large glass bottle holding say eight liters, and two of half the size. Paint the outside of these bottles with several coats of black paint or varnish. Fill the large bottle with the standard solution, and after it has stood a proper time fill one of the smaller bottles from it without shaking and standardize. At the same time fill the second small bottle, and refill the large one. When the first small bottle is exhausted standardize the second one and fill the first from the stock. When this is exhausted standardize the first again and fill the second from stock, refilling again the stock bottle and so on. By this means a constant supply of sufficiently matured permanganate is always available. Of course if the consumption is very large, larger bottles or more of them may be required. Since changes of temperature affect the volume of all solutions, it is desirable that the permanganate solution should be used at the same temperature at which it was standardized. With the strength of solutions above recommended, if the permanganate is used at a temperature of 20 degrees Fahr. different from that at which it was standardized the error amounts to less than 0.05 per cent. in a pigment containing 80 per cent. of sesquioxide of iron.

The mercuric chloride solution is made by adding to a bottle containing about a pint of distilled water two ounces of chemically pure mercuric chloride, filtering if necessary. A saturated solution is desired for use and the above amount of mercuric chloride is sufficiently in excess, so that water can be added from time to time.

The phosphoric acid solution is made as follows: Add 160 grams of chemically pure manganous sulphate, obtained in the market, to sufficient water, and when solution is complete dilute to 1,750 cubic centimeters. Then add 330 cubic centimeters of syrupy phosphoric acid, 1.70 specific gravity obtained in the market, and 320 cubic centimeters of concentrated chemically pure sulphuric acid. Mix thoroughly, filter if necessary, and keep in a well-stoppered bottle.

#### CALCULATIONS.

An example of all the calculations is given herewith. The softsteel employed in standardizing permanganate of potash solution in the Pennsylvania Railroad laboratory contains 99.27 per cent. metallic iron. 0.1498 gram of this contains therefore (.1498  $\times$  .9927) .1487064 gram of metallic iron. This requires 42.99 cubic centimeters permanganate solution, or 1 cubic centimeter of permanganate solution is equal to (.1487064 : 42.9) .003466 metallic iron. But metallic iron is to sesquioxide as 112 to 160 ( $Fe_2$  to  $Fe_2O_3$ ). Hence 1 cubic centimeter of permanganate is equal to (112 : 160 : : .003466 :  $\times$ ) .004951 sesquioxide of iron. Twice the number of cubic centimeters used in the analysis, since half a gram is taken, multiplied by this factor, gives the sesquioxide of iron in one gram of the pigment, and this multiplied by 100 gives the percentage.

#### NOTES AND PRECAUTIONS.

It will be observed that this method is almost exactly the Zimmerman-Reinhardt method, described by Mixer and Dubois in the *Journal of the American Chemical Society* for May, 1895. In our hands the method has given such admirable results that we use it wherever possible.

The pigment frequently adheres with considerable tenacity to the sides and bottom of the flask used in separating it from the other constituents of the paint. Moreover, the constituents of the pigment separate from each other in the gasoline solution, the heavier particles being at the bottom. It would lead to error, therefore, to take sufficient material for an analysis out of the flask without previous care to secure a uniform sample. The flask should be well cleaned, and the whole amount thoroughly mixed before weight is made.

Pigment separated from oil by means of any solvents is apt to contain some organic matter, possibly oxidized oil, or traces of the unoxidized oil, not removed. Moreover, the passenger car color pigment contains as an essential constituent organic coloring matter. These substances interfere with the subsequent titration with permanganate, and must accordingly be removed. This is apparently easiest done by ignition as described. If very high temperatures are used, the subsequent solution will be more difficult.

The use of stannous chloride to facilitate solution and also to reduce the iron requires some precautions. The more stannous chloride there is present before the mercuric chloride is added, the more of this latter reagent must be added to decompose it, since it is impossible to titrate in presence of stannous chloride. But the more mercuric chloride added to decompose stannous chloride, the more mercurous chloride there is present in the solution to be titrated. Experience shows that this mercurous chloride may lead to erroneous results in the titration. If the material to be titrated is opalescent only from suspended mercurous chloride, entirely satisfactory results may be expected. If, on the other hand, a voluminous precipitate of mercurous chloride is present, the results may be seriously in error, possibly due to a reaction between the mercurous chloride and the permanganate.

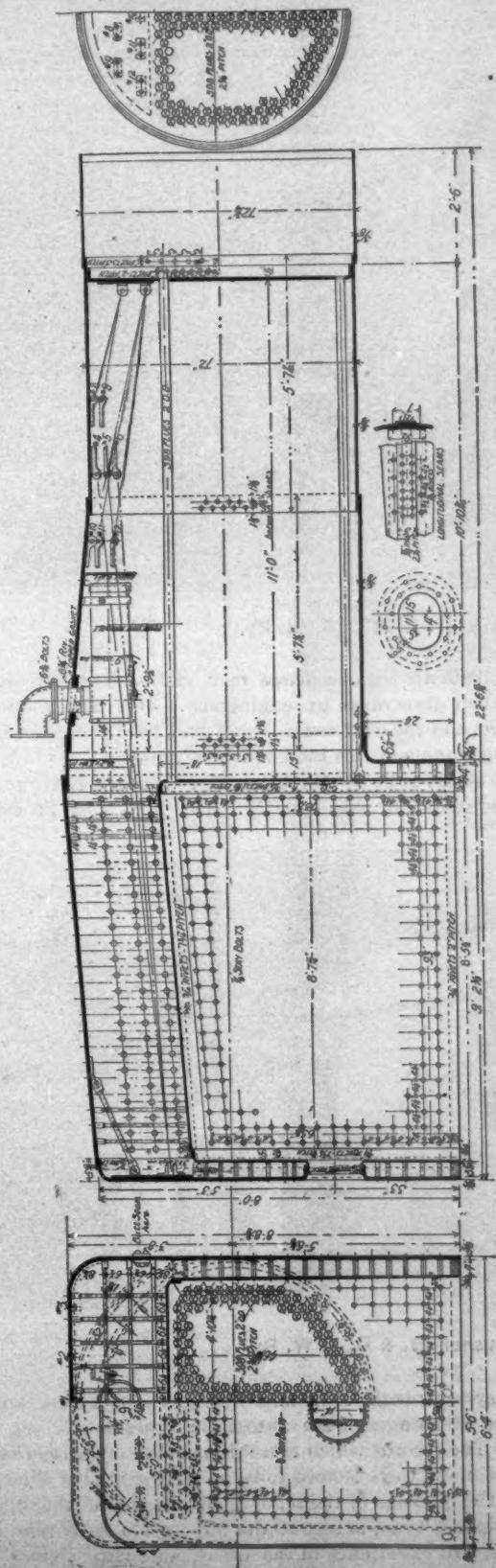
The use of the phosphoric acid solution enables the titration with permanganate to be made in presence of hydrochloric acid, and thus avoids displacing this acid by sulphuric, and the use of the reductor, which are characteristic of the older methods. Apparently the manganese sulphate is the important factor in this possibility, the phosphoric acid being added to give a colorless solution, so that the end of the reaction may be observed with sufficient sharpness.

It will not escape notice that if the manganese sulphate, the phosphoric acid, or the sulphuric acid, used in making the phosphoric acid solution, any or all of them contain iron in the protoxide form, or even organic matter, an error may be introduced in the titration. It is well, therefore, to test this solution with permanganate before using it. If the same amount that is required for an analysis uses up more than one, or possibly two drops of permanganate, the amount actually so used up must be deducted from the figures obtained in the regular titration.

**Belpaire Stationary Boilers—Grand Central Station, New York.**

The general arrangement of the improvements in the Grand Central Station in New York were illustrated in the AMERICAN ENGINEER, CAR BUILDER AND RAILROAD JOURNAL of March, 1897, page 104. The statement was made at that time that this station would be one of the best appointed in the world when completed, and the work that has so far been done confirms that opinion.

The plans include a new power plant which is to furnish the steam and electric power and the steam for heating and the disposition of this plant in the basement of the building without



**Belpaire Stationary Boilers.—Grand Central Station, New York.**

making extensive and expensive changes was interesting and rather difficult.

The steam plant is situated opposite Forty-third street on the Vanderbilt avenue side of the building, and the head room was limited to 10 feet 6 inches, which made the problem of installing 1,500 horse power in boilers an unusual one. No domes could be used and the steam piping was to be kept low. The space was too restricted to admit of using a water tube or a horizontal tubular type of boiler, and after considerable study the Belpaire type was chosen, and the height of the boiler itself was kept down to 8 feet 8 $\frac{1}{4}$  inches, which will be seen to be remarkably low for a boiler of 208 horse power without resorting to a type that would not be suitable for this purpose. It is by no means unusual for this type to be used in stationary practice, and it possesses distinct advantages over the cylindrical return flue type. The firebox is surrounded by effective heating surface, and the setting is more simple and cheap, and there are no losses due to leaky settings. Boilers of the locomotive type should be carefully insulated by non-conducting coverings, and we are informed that this has been attended to in these boilers.

There are seven boiler spaces provided in the power room, and six boilers will be used. They are designed for a pressure of 150 pounds. The diameter of the shell is 72 inches at the smallest ring, and the length is 22 feet 7 inches. The flues are 398 in number, and are two inches outside diameter by 11 feet long. The tube sheets are  $\frac{1}{2}$  inch thick, the crown sheet is  $\frac{1}{4}$  inch thick and the other sheets are  $\frac{1}{8}$  inch thick with the exception of the throat sheet, which is  $\frac{1}{4}$ -inch. It was the intention to make the outside firebox sheet all in one piece, but it was decided to make it in three pieces as shown in the sectional view. The grate area is 45.6 square feet, the firebox being 66 inches wide and 101 $\frac{1}{4}$  inches long inside. The heating surface is 2,494.3 square feet, of which 2,288.5 square feet are in the flues, and 205.8 square feet are in the firebox. The grate area is 45.6 square feet.

The dry pipe is a wrought iron pipe of 9 inches inside diameter, and is supported near the top of the boiler, as shown in the drawings. The steam enters through 15 two-inch holes in the top of the pipe, and water is allowed to drip from three 8-inch holes in the bottom of the pipe. The steam is led away through a 6-inch pipe and elbow. It will be noticed that a baffle plate is hung from the shell in front of the dry pipe, for the purpose of preventing the rush of water to the pipe.

The grates are of the cast-iron stationary type arranged for the burning of "pea" coal. The frames are held by studs on the inside of the firebox. It will be seen from the drawing that the water spaces around the firebox are not uniform, the space at the front being 4 inches. The space at the top of the sides is 5 inches and is 4 inches at the bottom. The space at the top of the end is 4 inches and at the bottom it is 8 $\frac{1}{4}$  inches. The crown sheet slopes downward toward the rear and it is supported by 1 $\frac{1}{4}$ -inch stays, upset at the ends to a diameter of 1 $\frac{1}{4}$  inches. The spacing of these stays is shown in the drawings. The short staybolts are  $\frac{1}{2}$  inch in diameter and the spacing is also shown in the drawings. The crown and cross-stays are of the same diameter. The flues are set with copper ferrules expanded into both sheets. The boiler is stayed longitudinally by the use of diagonal stays of 1 $\frac{1}{4}$ -inch round rods secured to crow feet at both ends. The form of the seams and the location of the washout plugs and the manhole are shown in the drawing.

The boilers were built by the Schenectady Locomotive Works, to specifications by Mr. William Buchanan, Superintendent of Motive Power and Rolling Stock of the road, to whom we are indebted for the drawings and information.

**1898 Conventions at Saratoga.**

We are informed by Mr. John W. Cloud, Secretary of the Master Mechanics' and the Master Car Builders' Associations, that the 1898 conventions will be held at Saratoga, N. Y. The Master Car Builders' convention will open Wednesday, June 15, and the Master Mechanics' convention will open on the following Monday, June 20. The dates have been incorrectly reported by several journals, but the statement given here is based upon official information from Mr. Cloud and is therefore correct. The headquarters will be at Congress Hall.

## Stone Crusher—B. &amp; O. S. W. Ry.

The Baltimore & Ohio South Western Railway has been using so much crushed stone in the permanent improvements on its lines as to necessitate the installation of a stone-crushing plant at the quarries, which are situated on the Rock Creek branch near Mitchell, Ind. The general appearance of the plant and its arrangement may be seen by the accompanying illustrations, which show it while under construction and after completion.

The quarry is of oolitic limestone and is practically unlimited in extent. It is very conveniently located with reference to the track and the stone is taken out and crushed with very little expense. The first illustration shows the framework and the machinery while it is being placed, and before the quarry was opened; the other view shows the crusher plant complete with the quarry opened.

The plant is divided into three parts: the boiler house, the crusher and the storage bins. The storage bins are over the tracks upon which the cars are run for loading. Steam is furnished by two boilers of the locomotive type and power is obtained by an old engine that was taken from one of the locomotive shops.

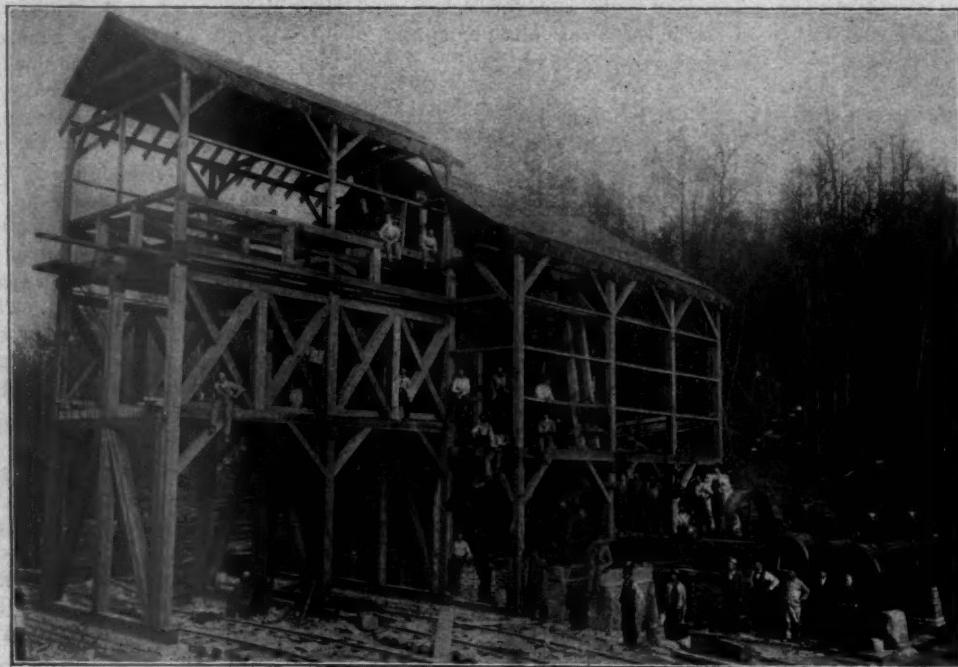
The crusher machinery was furnished by the Gates Iron Works, and consists of one No. 7½ and one No. 4 crusher, both being of the Gates pattern. The stone from the quarry is first run through the No. 7½ crusher and is carried by heavy elevators to a revolving screen where the dust and fine stone are screened out and any stone that passes through a 2½-inch hole goes through the screen and into the ballast bin. The stone that has not been crushed fine enough to pass through this part of the screen is run out of the end of the screen and through a rejection spout to the other crusher, where it is recrushed and re-elevated to the screen. In this way the stone is made of even size, which is essential in the production of good ballast.

The plant is complete in every way, and it is used for the production of crushed stone for many other purposes than for ballast. It will be seen that the quarry is very favorably situated with reference to the crusher with respect to the handling of the material, and while we are unable to state the cost of the working, it is said to be very low. The capacity of the plant when the quarry is completely opened will be between 600 and 700 yards per day; at present it is from 100 to 150 yards per day, and this may be increased at any time by opening up the quarry to a greater extent. We are indebted to Mr. I. G. Rawn, General Superintendent, and to Mr. J. H. Maddy for the photographs and information concerning this plant.

The capping of firebox sheets to preserve staybolts, referred to on page 331 of our issue of September, 1897, was discussed at the November meeting of the Western Railway Club, the service reports being very favorable.

## Automatic Signals.

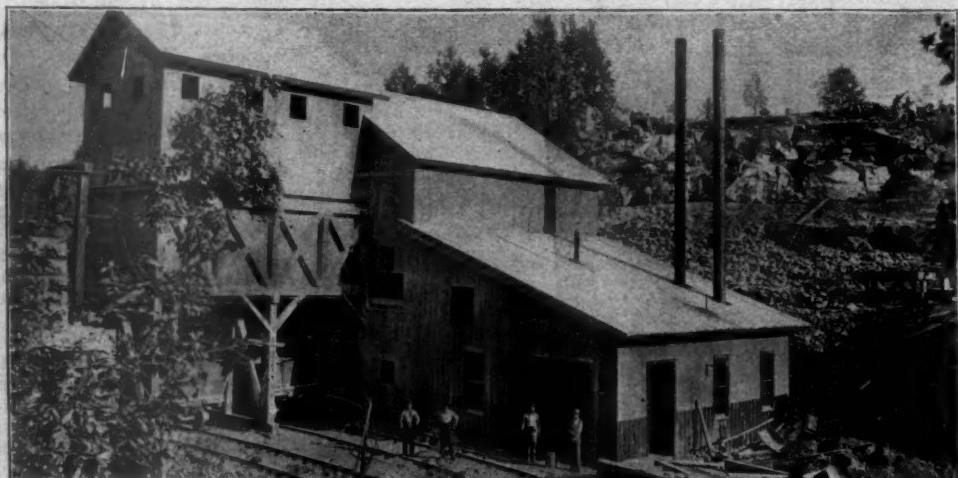
The subject of automatic signals was discussed at the recent meeting of the Railway Signaling Club in Chicago, it being introduced by a paper by Mr. V. K. Spicer. The conclusion to be reached from the discussion was that there was a growing tendency to look upon automatic signaling as a safe and desirable system. The old objections to these signals are mentioned, and



Stone Crusher—B. &amp; O. S. W. Ry.

among them are the absence of men stationed at the signals to insure their observance by enginemen. This was a question of discipline and the confidence which had been imposed in automatic appliances of this kind had been growing.

There seems to be no doubt that there is a specially good field for these signals in this country. The high cost of controlled



Stone Crusher—B. &amp; O. S. W. Ry.

manual systems both for installation and for operation tended to make the advantages of the automatic types stand out prominently. The records which these signals had made were favorable to them and there seemed to be no well grounded objection to them. The question of the relative advantages of the disk and the semaphore types of signals did not receive attention, and in view of recent experience in the use of automatic signals of the semaphore type, as recorded in our issue of last month, and the

fact that all the prominent signal companies are prepared to furnish the semaphore type goes to show that those who prefer semaphores may be supplied with them, and that they may be relied upon. The disk signal has given an excellent account of itself and in fact the reputation of the automatic signal has been made by disk signals.

The conditions which obtain on most of the railroads in this country preclude the possibility of using the controlled manual system even if the necessary investment to install it is available. It is well established that automatic signals can be made to work in a perfectly reliable manner if the necessary care is taken in the construction of the apparatus and in the installation. Much has been learned in regard to the best methods of wiring and arranging the circuits with reference to ease of inspection and repair, so that it may now be said that the protection afforded may be complete. So much more signaling of the automatic type may be obtained for one's money than the cost factor cannot be neglected, and while some say that cost should not enter into the question of railroad signaling the fact remains that it does enter and, more than that, it stays in the question. Those who do not believe that it is the legitimate function of signaling appliances to pull a drunken or otherwise incapacitated engineer off his engine for disregarding its indications and discipline him forthwith are inclined to think that the automatic devices are on the whole more reliable than the manual. After all is said, the manual systems, even if they are locked or "controlled," must rely upon automatic devices almost as much as the purely automatics, and when these locks fail or become "tied up," as they sometimes do, the case of the manual is worse than that of the purely automatic. We are of the opinion that the controlled manual system will not make very much headway in this country.

Permissive working must at times be resorted to under the controlled system, and we ask: Is it not better to put in automatic signals and make the blocks so short as to take permissive working out of the question altogether?

The most recent development of automatic signals which is arranged upon the normally danger plan, as described in our December, 1897, issue, is worthy of study, and if in experience it bears out expectations we believe the type of signals represented will find favor.

#### The Raddatz Submarine Boat.

We record the appearance of a new submarine boat designed and built by Mr. Richard Raddatz, of Oshkosh, Wis., which has been undergoing experiment in Lake Winnebago, at that city. It is understood that the boat is propelled by a hot air engine when running on the surface and by an electric motor and accumulators when under the surface. The method of supplying air to the occupants has not been explained by Mr. Raddatz.

In view of the interest which has been taken in submarine boats, we have obtained a statement from the inventor with regard to the performance of the craft and reproduce it in his own words as follows:

This craft is cigar-shaped, 65 feet long, 4 feet in diameter and  $7\frac{1}{2}$  feet high at the highest point. It is built of  $\frac{1}{2}$ -inch armor steel on a heavy steel framework, and is estimated to be of sufficient strength to withstand the pressure due to a submergence of 500 feet. The forward end of the boat is armed with a heavy steel spur capable of doing considerable damage. At the rear end is a two-bladed 30-inch propeller wheel. Projecting beneath the boat, at the stern, near the propeller wheel, is a long steel rudder, capable of turning the boat in twice her length. The weight of this craft ready for service is somewhat over 81 tons. She has attained a surface speed of about 14 miles an hour with an expenditure of from 40 to 45 horse-power. When under water the craft is propelled at a rate of from one to ten miles an hour by electricity. It is easily capable of completely disappearing beneath the surface of the

water from surface condition in about 60 seconds, and has accomplished this during a test made to determine this question in 18 seconds. It has, likewise, in the same short space of time been brought to the original surface condition.

With three men on board it has remained under water for over three hours at a time without the least inconvenience to the inmates or any ill after effects, the passengers declaring that as far as the condition of the atmosphere in the boat was concerned, they were willing to have remained down another three hours. On one day of 10 hours,  $8\frac{1}{2}$  hours were spent under water, the air being maintained in a pure condition during this length of time with three and four passengers on board, demonstrating clearly that with two passengers the boat can remain submerged for 20 consecutive hours with no ill effects. During all the tests made the air machinery has shown itself capable of supplying in proper quantities all the air needed, not only for respiration but likewise for the supply of three ordinary sperm candles used for illuminating gages and indicators. During another test, lasting for over three hours, with three men on board, and made to determine the capability of the vessel to maintain a level keel, it was shown that the air bubble in an ordinary spirit level would not vary at all from the level-mark to show that the vessel had been in any way tilted or inclined. To demonstrate the capability of the vessel maintaining itself at a constant depth, passengers inside the boat checking off the depth on an external manometer and observers stationed in service boats supplied with graduated rods and having connection with the boat by means of ropes marked to show the depth, proved, by their observations, that a constant depth was maintained for a period of over one hour with almost no variation as far as they could detect by the means employed. During the experiments over 300 descents have been made. After the first half a hundred trials no accidents whatever have occurred. Between 60 and 70 different people have been taken for



The Raddatz Submarine Boat.

more or less extended voyages beneath the surface, in every case resulting to the complete satisfaction of the passengers.

#### It Was Play For Him.

The train ran off the track and plunged down a steep embankment.

Engine, baggage car, coaches and sleepers were jumbled in one awful mass.

The groans of the injured passengers rent the air.

It was frightful!

Jones, the world-renowned halfback, partially awoke.

Three passenger cars were piled on top of him.

A piece of pipe was coiled around his neck.

The rim of one of the great driving wheels of the engine rested on his face.

His legs were pinned down by a heavy beam.

A pillow had been forced against his mouth and nose, making it impossible for him to breathe.

His arms were pressed against his sides and he tried in vain to move.

But willing hands were at work upon the wreck, and at last Jones, the world-renowned halfback, was dragged out.

Looking around in a dazed sort of way, at his rescuers, he asked: "How many yards did we gain on that 'down,' boys?"—*Cleveland Leader*.

#### M. C. B. Standards in Repairs.

By a recent decision of the Arbitration Committee of the Master Car Builders' Association, more prominence is given to the admissible use of the M. C. B. standards in place of original parts, even though the standards differ considerably from the originals. The case in question (No. 496) concerned a broken oil box replaced by an M. C. B. box to a Southeastern Line car by the Chicago & Eastern Illinois Railroad. The Southeastern people claimed that the repairs were wrong, inasmuch as the boxes differed as regards lips for the arch bars, but the decision favored the use of the standard.

(Established 1832.)

**AMERICAN  
ENGINEER  
CAR BUILDER AND RAILROAD JOURNAL.**

29TH YEAR.

67TH YEAR.

PUBLISHED MONTHLY

BY

R. M. VAN ARSDALE,

MORSE BUILDING.....NEW YORK

G. M. BASFORD, Editor.

JANUARY, 1898.

**Subscription.**—\$2.00 a year for the United States and Canada; \$2.50 a year to Foreign Countries embraced in the Universal Postal Union. Subscriptions for this paper will be received and copies kept for sale by the Post Office News Co., 217 Dearborn Street, Chicago, Ill.

**EDITORIAL ANNOUNCEMENTS.**

**Advertisements.**—Nothing will be inserted in this journal for pay, EXCEPT IN THE ADVERTISING PAGES. The reading pages will contain only such matter as we consider of interest to our readers.

**Special Notice.**—As the AMERICAN ENGINEER, CAR BUILDER AND RAILROAD JOURNAL is printed and ready for mailing on the last day of the month, correspondence, advertisements, etc., intended for insertion must be received not later than the 20th day of each month.

**Contributions.**—Articles relating to railway rolling stock construction and management and kindred topics, by those who are practically acquainted with these subjects, are specially desired. Also early notices of official changes, and additions of new equipment for the road or the shop, by purchase or construction.

**To Subscribers.**—The AMERICAN ENGINEER, CAR BUILDER AND RAILROAD JOURNAL is mailed regularly to every subscriber each month. Any subscriber who fails to receive his paper ought at once to notify the postmaster at the office of delivery, and in case the paper is not then obtained this office should be notified, so that the missing paper may be supplied. When a subscriber changes his address he ought to notify this office at once, so that the paper may be sent to the proper destination.

The paper may be obtained and subscriptions for it sent to the following agencies: Chicago, Post Office News Co., 217 Dearborn Street. London, Eng., Sampson Low, Marston & Co., Limited St. Dunstan's House, Fetter Lane. E. C.

The American Society of Civil Engineers formally opened the new house on West Fifty-seventh street, New York City, November 24, with exceedingly interesting and appropriate ceremonies which constituted a marked recognition of the services of the engineer in the world's progress. The new home of the Society is exceedingly handsome and is admirably adapted to its purpose. We congratulate the Society on this event, which undoubtedly will mark the beginning of a new era in its honorable and useful career.

A few years ago any suggestion looking toward a decrease in the illuminating power of locomotive headlights would have received scant courtesy from railroad men, and, out of the high regard for strong illumination ahead of the engine, electric headlights came and for a time made considerable progress. With the advances in signal protection and the isolation of the right of way a change has come, and there is a marked tendency to regard electric headlights as an element of danger rather than of safety. As a prominent Master Mechanic puts it, "The electric headlight at best only gives an engineer time to get scared when he sights an obstruction," and he advocates the use of smaller headlights. There is a question of cost to be considered in connection with even the ordinary style, for, as Mr. Sanderson says

in his paper recently read before the New York Railroad Club, a saving of from \$6.50 to \$10.50 per engine may be made by substituting a 16 or a 12-inch headlight for the 28-inch size. Mr. Sanderson says: "There is a positive danger in using a very brilliant and powerful headlight, such as some of our electric friends are interested in, for the reflected glare off the surface of the switch lamp lens is often so great that it entirely overpowers the light coming from the lamp, and will show apparently white light to the engineman while the signal may be standing at red or green. For safety a runner must therefore look for the position of a target or semaphore and not trust to the lights at night."

Comparatively little is known about the effects of changes in the ratio of expansion in multiple expansion engines, yet this must be considered as one of the most important items in the design of such engines. It is worthy of note that there is a wide difference of opinion among the different locomotive builders as to the best ratio between the cylinders of compounds, and it is to be hoped that information will soon be available to enable designers to work intelligently in this direction. The ratio of expansion troubles marine and stationary engine builders quite as much as it does the locomotive men, and this subject was one of the most interesting and valuable of all those brought before the recent meeting of the American Society of Mechanical Engineers. Professor Thurston, in his paper entitled "Multiple-Cylinder Steam Engines, Effects of Variation of Proportions and Variable Loads," describes tests upon a Rockwood type of compound stationary engine having a cylinder ratio of 7 to 1. The tests were made upon a triple engine of which the intermediate cylinder was omitted, giving the ratio stated. This resulted in a surprising economy. The triple expansion engine worked most economically under a load of about 115 horse-power, but the 7 to 1 compound used less steam at all loads under 85 horse-power. It also used less steam than a compound engine having a ratio of 3 to 1 at all loads above 72 horse-power. The Rockwood compound has been known to give high economy, but it has been thought to be accidental until these experiments showed that there is more than accidental to account for the economy. We cannot tell where this will lead us, but it is very likely to exert an influence upon the future of the multiple expansion engine. More data are needed, and it is probable that more work will be done in this direction in the near future.

The Interstate Commerce Commission has taken action on the petition of the railroads in the matter of an extension of time for the equipment of cars with automatic couplers and air-brakes in what must be considered a very satisfactory way. The time has been extended two years and this will give all of the roads sufficient time to comply with the requirements. The arguments of the roads brought out the fact that the condition of the railroad business since the passage of the act has been a serious obstacle in the way of many of them. Another reason for an extension of time was the hardship that would be occasioned if the cars not equipped should be prevented from being used in interstate traffic. This would cause such a scarcity of cars as to seriously embarrass shippers. It is by no means to be inferred that the Commission in extending the time for a period of two years is to be lenient in the matter of carrying out the provisions of the law, and while there will probably be no conditions in the extension, a careful watch in the form of equipment reports will be kept as to the progress made by the roads, and it behoves the roads to make all the progress possible in the matter. The railroads wanted an extension of five years and at first the Commission was inclined to grant an extension of only one year. Neither of these propositions seems to be as wise and fair as the one that was finally agreed upon, and with good prospects for business there should be no difficulty in completion of the applications of the couplers and air-brakes in that time. There is an additional reason why the roads should use every effort to put on air-brakes and automatic couplers as rapidly as possible, in that cars thus equipped may be operated more economically than at pres-

ent, owing to the fact that the coupling together of automatic and non-automatic couplers causes much more expense for maintenance than when the couplers are uniform, and also the best use of air-brakes cannot be had unless all or nearly all of the cars of the trains are equipped with them. The railroads are to be congratulated upon the decision that was reached by the Commission.

#### TROLLEY CAR ACCIDENTS.

The frequency and the serious character of the accidents occurring on the street railroads which are in so many cases paralleling steam roads calls attention in a forcible way to the dangers of present day street railroading and the comparative safety of travel by the substantial roads. The papers which came into our office in a single day recorded three accidents to trolley cars each attended with fatal results, and we think it time to call attention to the fact that it is dangerous to play with fire. It is high time to look out for the future, because accidents, in all probability, will increase faster than the growth of business. We submit that the trolley roads are not properly protecting their passengers, taking this ground on account of the absurd things that are commonly done on these roads that would not be countenanced upon trunk lines for a moment. The first requisite is good management and discipline, and the next is better safety and braking appliances; how absurd it is to think of applying the brakes of a heavy motor car with the slow crank handle and how iniquitous it is to permit the use of chilled brakeshoes in any service for the sake of the great durability thus obtained! These roads will soon be faced by the wrath of an enraged public if their ways are not mended. This is no excuse for the irresponsibility of the methods often followed on the street lines. The steam roads have learned to regard the safety of their patrons, and they, for the most part, are trying to provide the maximum of safety, while a great indifference and an implicit trust in the kindness of Providence is apparent in the methods of street and electric lines. The speculative features of these railroads would not suffer by the employment of correct principles of railroading, but would be improved by them. It has already been noted in these pages that an act to place the inspection of the street lines as well as the steam roads under the care of the State Railroad Commissioners has been passed in Massachusetts, and other States must follow if the initiative is not taken by the roads themselves. Conditions in street car traffic have changed with astonishing rapidity, and the fault is that methods of operation have lagged far behind the necessities of the case. The public makes its demands known to the trunk-line railroads in short order when accidents occur, and why the street lines are not held up to the same standard of safety in operation is unaccountable.

#### STEEL FREIGHT CARS—M. C. B. DESIGNS.

Numerous signs point to the fact that we have, in this country at least, reached the steel car age. The years 1896 and 1897 will be notable as the time when steel car construction in the United States was first undertaken in a serious manner and placed on a commercial basis. In 1896 sufficient experimental work was done to enable a committee of the Master Car Builders' Association to present a report confidently recommending certain forms of construction and illustrating them with fairly good designs. At the 1897 convention another committee recommended three different designs for underframes for 30-ton cars, one of which (we will designate it as Type A) had no truss rods; one (Type B) had wooden end sills, wooden draft timbers and small wooden longitudinal stringers bolted to the long channels; while the third (type C) had neither buffer blocks nor buffers, the draft rigging being attached to suspended plates riveted to the center channels. In order to bring the work of the committee into some uniformity certain principal inside dimensions of the box car were agreed upon and it was suggested that they be submitted to letter ballot as a recommended standard of the Association. This portion of the report was adopted and approved by letter ball-

lot; and the recommended standard of the M. C. B. Association for the general dimension of a box car with steel underframe is as follows:

Inside length and width, 34 feet by 8 feet 4 inches.

Height from rail to top of floor, 4 feet 2 inches; from floor to plate, 7 feet 6 inches.

Side door, 5 feet 4 inches; end door, 24 by 36 inches.

End sill flush—not projecting.

These dimensions have to do chiefly with the upper framing, and might have been very useful for wooden cars if adopted years ago; but we believe they will be of little use for cars with steel underframes, for it is likely that few steel cars of 60,000 pounds capacity will be built, and when steel is introduced advantage will be taken of its superior strength and the car capacity will be increased to 70,000 or 80,000 pounds for grain cars, and they will of necessity be made of greater length. The further action of the M. C. B. Association on the subject of steel cars was the appointment of a new committee to study the designs already presented and obtain criticisms upon them, and, if possible, to recommend a design for adoption. This committee has just sent out a circular of inquiry, in which they ask: What parts should be made of wood? Are independent draft timbers recommended? Should wooden end sills be used? What type of center-plates and side-bearings should be used? We shall take up some of these questions and discuss them briefly in connection with a criticism of the plans in the 1897 report, and with a general consideration of the subject of steel cars.

Of the three designs for steel cars presented at the 1897 convention, we would favor the one without truss rods and with deep centre sills, which we have designated as type A. This car has the draft rigging strongly riveted to the center sills, so that compressive and draft shocks are transmitted directly through them, and there is no tendency to deflection, as must be the case if the compression stresses are applied below the sills, as in all other designs in which suspended draft timbers or plates are used. We regard this principle as fundamental, and it is a mistake not to take advantage of it, as can be so easily done in steel car construction. The design, type A, has a steel-channel end sill, with a substantial oak buffer block,  $7\frac{1}{2}$  inches thick, to which cast iron buffers are attached. This amount of timber ought to provide a sufficient cushion for buffing, and it should prevent the rigid transmission of shocks to the rivets which is so much feared by some in regard to steel cars. The other two designs show extreme conditions in their provisions for this action—type B having a wooden end sill, wooden draft timbers and wooden buffer blocks, but no buffers, while type C shows neither wooden buffer blocks nor cast buffers—and yet we have the statement of the designer that the car has been in service five years without any expense for repairs. With a good oak buffer block we do not believe it is necessary to have a wooden end sill in steel cars, and a much more substantial design can be made without it.

The principal meritorious features in the design type A are as follows: (1) The car weighs less than a wooden car of the same general dimensions, and is much stronger. The weight of the steel frame is 6,959 pounds and the wooden joist for attachment of wood floor, bolts, etc., weighs 962 pounds, making a total of 7,922 pounds, while corresponding parts of a wooden car weigh 9,626 pounds, a difference in favor of the steel frame of 1,704 pounds.

(2) Only commercial shapes are used allowing competition in purchase of material.

(3) Every part is easily accessible for inspection and nearly all rivets can be driven by power.

(4) The main strength is in the center sills, which are 15 inches deep.

(5) Vertical strength is provided with moderate weight without the aid of truss rods.

(6) The draft gear is between the center sills and directly attached to them.

The whole design of type A is intended to secure horizontal rigidity, with the idea that distortion is not admissible in steel construction, and if provided for cannot be regulated within the

limit of elasticity of the material. The elastic resistance should be in the springs and wooden buffer blocks, where shocks are first received, and not in the frames. To make a car flexible without cracks it must be made largely of wood. This is the principle upon which type B has been designed. It has good sized wooden side sills attached to the side channels, wooden end sills and draft timbers and truss rods. The car seems to have been designed with the idea of giving it constant repairs, and we believe that if cars were built upon that plan the cost of repairs would be more than for ordinary wooden cars. The objections to type C are (1) the very light channels, (2) the use of truss rods, (3) the suspension of the draft gear below the center sills, (4) the absence of buffer blocks and buffers.

In the discussion of the three M. C. B. designs for steel cars we have incidentally answered some of the questions asked by the committee. (1) The only wooden parts necessary on a steel underframe are sufficient joist for the attachment of the floor and substantial buffer blocks; wooden end sills are not necessary. (2) Truss rods are not necessary, and the equivalent weight of metal could be better employed in deeper center sills. (3) Independent draft timbers are not admissible, and we believe them to be the very things to get rid of in steel cars.

In further support of the idea that truss rods should not be required in steel cars, we call attention to the tests of the 80,000-lb. flat car constructed by Mr. Pennock in 1895, and used in severe service at the works of the Carnegie Steel Company about one year. The car was then tested at the works of the Universal Construction Company, Chicago, by placing a load of 140,000 pounds of pig iron between the truck centers, giving a deflection of only  $1\frac{1}{2}$  inches at the center. A load of 159,000 pounds was distributed on the car by placing 45,000 pounds at each end and 69,000 pounds in the center portion, resulting in a deflection of  $\frac{1}{2}$  inch at the ends and  $\frac{1}{4}$  inch at the center. Under all these severe conditions the elastic limit of the metal had not been reached. The car weighed only 22,620 pounds. The Harvey steel flat car of 60,000 pounds capacity, with truss rods, tested at the same works, weighed 24,080 pounds and under a load of 119,000 pounds distributed between the truck centers it deflected  $1\frac{1}{2}$  inches. The conclusion we would draw from these tests is that the car without truss rods weighed less and deflected less under a greater load similarly located.

The other two questions in the circular of the M. C. B. Committee relate to center plates and side bearings, and these we regard as among the most interesting and vital matters of detail which will be rapidly developed by the use of steel cars of large capacity. It is surprising to find that in the 100,000-lb. steel cars, now building, the center plates are of the ordinary form and the area of the bearing surfaces has been enlarged to a very slight degree above those in 60,000-pound cars. Under such conditions we should expect the frictional resistance to curving to be very great, and sufficient to cause rapid flange wear and increased train resistance. It does not seem to be good mechanical construction to place two rough or unfinished soft steel disks about 12 inches diameter together under a load of 70 tons and expect them to rotate easily. The service is similar to that of a locomotive turntable, where, with a lever-arm about 12 times that on which the truck acts, there is proper provision for friction at the center bearing. These bearings are of several types; one most generally used consists of a nest of conical roller bearings made of hard steel placed in a steel case and all carefully finished. Another form employs disks 8 or 10 inches in diameter, having a slight concave and convex surface, one made of steel and the other of bronze. For large-capacity cars some such form of center bearings should be used, and they could be made cheaply by casting the cones or disks of hard steel and grinding to size. This is our recommendation for center plates, and the side bearing should have attention as a matter of rational design to make it properly fulfill its function. In the present article we have considered the steel car in connection with the work of the M. C. B. Association and have not allowed ourselves space to point out the economic features of the subject, which relate to large capacity and weight, first cost, deterioration by corrosion

and repairs, but we hope to discuss these features in our next issue.

#### Y. M. C. A. INFLUENCE IN RAILROAD WORK.

One of the greatest and most permanent of the advances of recent years in railroad matters is the great change which has begun and is now at work in the direction of applying the principles of sociology to the relations between officers and men. Some of the most significant indications of a deep interest on the part of officers in their subordinates are the rapid strides which have been made by new methods of discipline, and by the rapid growth of the Railroad Young Men's Christian Association idea. There are other indications which may be traced to the Y. M. C. A. movement, and it may be said that even the improved discipline is a direct result of its influence.

That there should be a high moral standard among railroad men has always been urged, but that the roads themselves had any obligations to the men in assisting to keep the standard high by surrounding them with influences tending to make it easier to retain good moral character amidst the temptations of the rough and ready life has not always been so clearly seen. Saloon influences and transportation responsibilities are incompatible, and officers are not only justified in discharging men who frequent saloons, but it is their duty to do so. Their duty, however, is not done unless other influences are furnished which will counteract those of the saloon and render them less dangerous because less attractive. The way this may best be done is to provide convenient, attractive and homelike quarters for the use of the men during their spare time and to surround them with good influences, and those educational advantages which are more appreciated by railroad men than by any other class.

There would be no labor problem if the idea of the Y. M. C. A. could be carried out among the men and among the officers. It is not alone the religiously inclined who are affected by the effort to place the men among pleasant surroundings and to give them educational facilities, but it is the religious influence that makes this movement so powerful. Its influence is to give men a view of their responsibilities in life, to show them the advantages of thrift, to educate them in connection with their work, and by bringing them together it helps them to become acquainted with their companions and shows them phases of the lives of their comrades which they would not otherwise see. It makes them more contented and tends to reduce the class of floating railroad men who owe allegiance to no friendly set of officers, and herein is a feature to be specially thought about. The officers can get better service from men with whom they are acquainted and in whom they are interested, and it is by no means the subordinates only who are benefited. The officers need improving quite as much as the men, and as Mr. H. D. Judson says, "One way to have more conscientious men is to have more conscientious officials who know their men and appreciate their fidelity to duty."

An indirect effect of this movement is seen in efforts which are made by several railroads to get their men to take shares of stock by a system of small payments. This is desirable because it touches the family life of the men, and that which they trust to the extent of investing their savings must then command their interest and conscientious efforts. Some officers believe in the Y. M. C. A. only because of its effects upon the earnings of the road. It certainly must affect them favorably, and we only ask such officers to come into close touch with the men through this instrumentality, in order to learn that which they sadly need to know, viz., that there is a success greater, more satisfactory and more honorable than any that may be measured in terms of dollars and cents.

A great many interesting facts concerning the Y. M. C. A. movement were brought out in the addresses at the recent 25th anniversary of the Railroad Branch of the Young Men's Christian Association at Cleveland, when it was stated that the idea was inaugurated at Northfield, Vermont, in 1850 by the establishment of a library for the employees of the Passumpsic Railroad. If

space permitted, an interesting and remarkable growth might be outlined, but that the movement has the support of the best and most successful railroad men is shown by the records of their opinions as they were shown at the occasion mentioned. Mr. Cornelius Vanderbilt expressed this opinion at the second convention, held 18 years ago, in the following words:

"I have for years felt the deepest interest in this work and believe that its importance can hardly be overestimated, both to the men and the companies in whose service they are. It educates and spiritualizes; it promotes economy and thrift; it brings railroad men together, with surroundings and discussions which produce the happiest results to themselves, their families and their employers."

The custom of providing meeting rooms for lectures and instruction is carried out to a considerable extent in England and we are rapidly waking up to the necessity for them as is shown by the ease with which the Chicago & Northwestern Railway has accomplished the erection of its new building in Chicago. Mr. Wm. Thaw, Vice-President of the Pennsylvania Lines West of Pittsburgh, was quoted, in regard to such rooms, as saying:

"I wish to assure you of my deep interest in the work and my desire to co-operate in establishing and maintaining at every point where employees are thrown together in considerable numbers just such a room as you have in the depot at Columbus. It is wholly good both for the men and the roads they serve."

The late President Roberts of the Pennsylvania was a staunch supporter of this work and with his clear understanding and accurate judgment he foresaw a great future before it. In laying the corner stone of the Pennsylvania Railroad branch in 1898, he said :

"For over forty years I have been laying corner stones for the Pennsylvania Railroad, but I never laid one for a building that means so much for this company and its employees as this corner stone for the Pennsylvania Railroad Department of the Young Men's Christian Association."

These paragraphs would not be complete without including some broad ideas which were expressed by Mr. E. T. Jeffrey, President of the Denver & Rio Grande, in an address to one of these organizations in saying that he had formerly thought it an impossibility for the operating of a railroad to have anything in common with religion or Sunday observance. He had changed his views and he was ready to say that, all sentiment aside, the railroad that was operated by a religious set of men was better off than one with an immoral and irreligious set. His words were :

"I am willing to stand anywhere in the United States and challenge contradiction from all quarters and all sides to that assertion. In considering and determining on right lines what is due between man and man, what is due by corporations to employees what is due from employee to corporation, in trying to look with clear-cut vision as to what is the right thing to do, the man who is actuated by Christian spirit and imbued with Christian love, and who is guided in the matter by Christian faith and teaching, is the one most competent to decide correctly."

He who comprehends Mr. Jeffrey's meaning and who puts it into effect will solve for himself the labor problem, and will exert an influence which is needed in the conduct of railroad and all other branches of business.

#### Specifications for Machine Tools.

The desirability of buying machine tools upon a guarantee of the manufacturers that they will meet certain definite requirements was shown by Mr. J. W. Gardner in a paper recently read before the Western Railway Club. For years it has been customary for the builders of engines and boilers, steamships and warships to guarantee their product to meet specified tests, and, of late the same practice has been carried out in the purchase of locomotives with the natural result of greatly improving the product in each of these lines, and it is likely that the same experience will follow the practice of specifying the work to be performed by machine tools.

Mr. William Forsyth has made the valuable suggestion in this connection, that the tool makers ought to state the specifications

in terms of the weight of the material which the tools will remove in a given time, thus giving a more intelligent idea of the capacity of the machine than may be had by a statement of the capacity in terms of feed in feet cut per minute. The question of whether the manufacturer or the purchaser is to make the specification does not seem to be important, but the capacity when stated in such positive terms would give an excellent basis for intelligent comparison between different machines. Probably the manufacturer would be able to give a more valuable opinion on this subject than the purchaser, and it is fair to expect that one who is prepared to say what his machines can do will be able to sell them better than one who can not. The idea of specifying the weight of metal which a machine will remove was evidently suggested to Mr. Forsyth by his observation of an English lathe, of which he said:

"I saw at the works of Hulse & Company, in Manchester, England, a large gun lathe which had four tool posts, with a screw in the center, and they told me that each one of these tools would remove 500 pounds of steel per hour, so that the capacity of that lathe was the removal of one ton of steel an hour. That gave me an idea of the capacity of the tool. In stating the cutting speed of a tool we give it in linear feet. We say a tool should travel 20 linear feet per minute, but we do not say anything about the depth of the cut, and that is where the power and efficiency of the tool come in, and when we combine the rapidity of the cut with the maximum depth of the cut, we get a measurement of the efficiency of the machine tool. This is really specifying the weight of the shavings to be removed, so that it seems rather a simple thing to make a specification for a machine tool based on the weight of cast iron or steel or brass which that tool will remove."

It is a simple matter for a manufacturer to ascertain the number of pounds of the various metals that may be removed in a given time by one of his machines with a tool of a given size and shape and one who can show that the machine he builds will do several times as much as old tools in a given time has a good argument as a basis for selling, and the purchaser will be able to profit by knowing exactly what he has purchased. The result ought to be a great improvement in shop practice.

Many questions pertaining to the relative advantages of the planer, the lathe, the boring mill and the milling machine for certain work could be settled by having these figures together with the cost of setting the work in each of the machines. One superintendent of motive power is on record as believing it to be possible to increase the output of old tools to such an extent as to cut the cost of repairs in halves. Whether he is exactly correct in his figures or not does not matter since the admission is made that a very large saving is possible even without the introduction of new equipment. In view of this fact it would appear to be worth while to experiment with the tools now in use with a view of ascertaining the amount of metal each can be made to cut away in the same length of time. In considering the purchase of new equipment this would give the officer the advantage of knowing how much he could afford to spend for the new machine which is necessary information. The capacities of machines must also be known in establishing piecework and there seem to be good reasons for believing that an inventory of the maximum output of each machine, new or old, would be a valuable possession.

#### NOTES.

The method of "laying" dust by sprinkling the roadbed with oil, successfully used by a number of roads during the past year, has been taken up by the New York, New Haven & Hartford on 11 miles of track.

A motor wagon driven by an oil engine has given what appears to be very satisfactory service for the post-office department in London for several weeks. The work is severe, and according to *Transport* the time made by the power wagon is shorter than that of the horse wagons, and the vehicle is likely to become a part of the "permanent staff."

Brown's discipline has been adopted on the Chicago, St. Louis, Amboy and Springfield divisions of the Illinois Central R. R. A

reprimand will be balanced by a clear record of three months; five days of suspension will be balanced by a clear record of nine months; 80 days will be balanced by a clear record of one year, and 60 days by a clear record of 18 months.

Two water tube boilers of the Haythorn type are to be used on a passenger steamer building on the Clyde. They will work under forced draft, with a closed stoke hold. According to *Engineering* each will have 1,700 square feet of heating surface, and furnish steam of 200 pounds pressure, to be reduced to 140 pounds at the engines.

The North German Lloyd ship, *Kaiser Wilhelm der Grosse*, beat the Southampton record on the trip arriving at that port November 29. The time from Sandy Hook to the Needles was 5 days 17 hours and 8 minutes, and the average speed was 22.35 knots per hour. The best eastward record previous to this was 17 hours and 6 minutes longer. The daily runs were 401, 520, 518, 528, 525, 507 and 71 knots.

An oil-distributing projectile for use on ships has just been patented. It consists of a hollow shell filled with oil and shaped like a rifle projectile. It is intended to be thrown ahead of a ship that is in distress from rough seas, and upon striking the water the oil charge slowly oozes out through a series of small openings controlled by a valve that opens when the projectile strikes the water. By throwing these shells ahead of the ship while moving it is expected that headway may be made against the roughest seas.

Keeping track of the mileage and preventing the detention of freight cars while on foreign roads are most difficult matters under the methods now in vogue, wherein the one using a car is expected to report such use to the owner. The *Railway Age* calls attention to the facts in connection with the Kansas City, Watkins & Gulf Railway and says: "Here are some of the facts shown: Car away from home 474 days and still missing; days accounted for, 817; held 72 days by one road, which paid \$4.08." Who calls this good railroading?

The proposed tunnel under the East River, for the use of the Long Island Railroad, which was the subject of a recent hearing before the city officers of New York and Brooklyn, is a much needed improvement in the transportation facilities between the two cities, and there seem to be no reasonable grounds for objections to the plan. The proposed tunnel would give the Long Island Railroad access directly into New York. The tunnel would be so deep as to avoid interference with the buildings and with any rapid transit tunnels that may be built, and we hope to be able to record favorable action in the matter at an early date.

The proposed lease of the West End Street Railway by the Boston Elevated Railway Company has been disapproved by the Railroad Commissioners of the State of Massachusetts, and the deal cannot go through in its present form, although it is likely that a new proposition will be made. The original proposition that was refused by the Commissioners provided for a lease for 99 years at a high rate of interest, and the refusal was based on the difficulty of guaranteeing this and at the same time providing for the reduction in rates that is expected to come in the ordinary course of events in the railroad business. A shorter term would probably receive more favorable action from the Commission.

The proposed ship canal from the Great Lakes to the sea was not favorably reported upon by Major Thomas W. Symons, who was appointed to investigate the subject under the River and Harbor Act of 1896. No military or commercial advantages at all commensurate with the cost were seen in the project. The types of ships on the lakes and the ocean were necessarily so different as to preclude the possibility of the same vessels being used in the traffic over such a waterway. The report was favorable to an enlargement of the facilities offered by the Erie Canal, and it was shown that the latter might be adapted to the use of large barges to good advantage. It would cost \$200,000,000 to construct a ship canal and \$2,000,000 per year to maintain it. The enlargement of the Erie Canal was recommended in the report.

As to the water-tube boiler, Commodore Melville, Chief of the Bureau of Steam Engineering, says in his annual report: "The Bureau feels that, with the experience now gained, the efficiency of the fleet will be best served by using water-tube boilers on future ships. As yet it can certainly not be said that any one of the numerous varieties of water-tube boilers is absolutely the best. Some of the ablest engineers in the world who, to cultivated talent add vast practical experience, have identified their names with particular forms of this type of boiler, and it is probable that, as experience accumulates, a form of boiler will be evolved embracing the best features of all of them. . . . The Bureau does not advocate any one form of boiler to the exclusion of the rest, but believes that the best results will come from giving contractors freedom of choice of a form of water-tube boiler, subject to certain conditions of scantlings, general design and workmanship, which the Bureau is prepared to lay down."

The 80-foot yacht *Ellide*, built for E. B. Warren, Vice-President of the Barber Asphalt Company, from the plans of Charles D. Mosher, says *Engineering News*, has made the astonishing record of 37.89 miles per hour. She thus beats the *Turbinia's* record of 37.7 miles per hour. The *Ellide* is 80 feet long overall, 8 feet 4 inches beam and 3 feet 6 inches draft. She is of composite construction, with a double mahogany skin, fastened by Tobin bronze bolts, and steel frames and scantlings. Five steel bulkheads divide the hull into six water-tight compartments, and there are in addition a number of copper air tanks. The motive power is a quadruple expansion engine, with 9, 13, 18 and 24-inch cylinders and 10-inch stroke. The Mosher boiler is practically that used in the new torpedo launches and in the submarine torpedo boat now building at the Columbian Iron Works in Baltimore. The speed trial trip mentioned was made on the Hudson River over a mile course measured by the U. S. Coast Survey, and this distance was covered in 1.35 minutes.

The improvement on the Pittsburgh Division of the Baltimore & Ohio Railroad, 22 miles west of Cumberland, at Falls Cut, has been completed and trains are running over it. Falls Cut is a cutting through a spur of the mountain and is about 60 feet in depth and has continually given trouble by rock sliding down on the track. Formerly it required bracing with heavy timber every few feet for its entire length, some 300 feet, and required constant care and watchfulness. It was, therefore, very expensive to keep up. In order to eliminate this cut it was necessary to build one mile of new roadway, which involved the construction of a double-track tunnel, 530 feet in length, and three bridges. By this change the road was straightened considerably, taking out some sharp curvature and introducing curves of longer radii. The improvement is on what is known as the eastern slope of the Alleghanies, and the grade is about 84 feet to the mile. The tunnel and bridges were constructed with the view of double tracking the entire Pittsburgh Division some time in the future.

The advantage of the track tank in passenger service is already appreciated by American lines, but the point seems to escape notice that in handling freight on a busy line there is much to be gained by this device, said Mr. George B. Leighton in a paper on "English Railroad Practice," read recently before the St. Louis Railway Club. Freight trains run from Crewe to London, a distance of upward of 150 miles, without stopping for water. The use of the track tank allows the use of smaller and lighter tenders. The standard tender of the London & North Western goods engine is only 1,800 gallons, but on this point English practice is not uniform. The Great Northern Railway, being part of the East Coast line to Scotland (one of the lines making the fast runs), does not use the track tank, and is thereby forced to carry a tender of large proportions and great weight. That is a point, it seems to me, that the American trunk lines do not appreciate; even some eastern lines that have track tanks in service for passenger work have not adopted them for freight. Why not use the track tanks in freight service as well as passenger, and thus avoid carrying this immense extra dead weight?

The ten United States naval dry docks have the following general dimensions:

	Length.	Breadth.	Depth of sill at high water.
Boston.....	396.5	60	25
Brooklyn.....	369.3	66	25
Brooklyn.....	500	85	25.5
Brooklyn.....	670	105.2	28
League Island.....	590	85	25.5
Norfolk.....	331.8	60	25
Norfolk.....	500	85	25.5
Port Royal.....	496	97	26.5
Port Orchard.....	650	92.7	30
Mare Island.....	513	79	27.5

In sailing to San Francisco, by way of Cape Horn, a United States war vessel might use one of the four dry docks at Rio Janeiro, the largest of which is the Sande Point dock, 520 feet long, 70 feet wide and 25 feet deep over the sill. At Montevideo the docks only provide for 17 foot draft; and at Talcahuano, Chili, is a stone dock 545 feet long, 80 feet wide and 28 feet deep. It is said that of the 748 dry docks in the world England owns about 60 per cent.; 249 of these being in England, 30 in Scotland and 18 in Ireland. Europe has 302 docks divided among 80 cities; Asia has 76, in 27 cities, and there are 22 docks in Oceanica and Australasia. The Liverpool docks, the largest in the world, cover 1,620 acres, with 36 miles of quay lines. The London docks cover 700 acres, and at Southampton is the largest single graving dock in the world—751 feet long, 88½ feet wide and 28½ feet deep on the sill.—*Engineering News*.

## Personals.

Mr. W. W. Layman has resigned as Master Mechanic of the Ohio River Railroad.

Mr. John E. Stearns has resigned as General Manager of the Boise, Nampa & Owyhee, of Idaho.

Mr. B. R. Hanson, Master Mechanic of the Texas Midland, was succeeded Dec. 1 by U. R. Smithime.

Mr. F. P. Boatman, Master Mechanic of the Columbus, Sandusky & Hocking shops, has resigned.

Mr. H. T. Porter has been appointed Chief Engineer of the Pittsburgh, Bessemer & Lake Erie, with headquarters at Pittsburgh, Pa.

Mr. V. A. Riton, for several years Superintendent of the Cascade Division of the Great Northern, has taken a position with the Norfolk & Western.

Nathan Wright, formerly Master Mechanic of the Mahoning Division of the Erie, died at Cleveland, O. Dec. 8, of pneumonia. He was 67 years of age.

Mr. C. M. Stansbury has been appointed Master Mechanic of the Pecos Valley Railroad, with headquarters at Eddy, N. M., to succeed Mr. G. F. Miller.

Mr. Alberto Villasenor, Master Mechanic of the Ferro-Carril Santa Ana, has been appointed Master Mechanic of the Ferrocarril Central, Salvador, C. A.

At a meeting of the directors of the Q & C Company, held in New York last week, Charles F. Quincy was elected President as well as Treasurer of the company.

Mr. W. B. Storey, Jr., Chief Engineer of the San Francisco & San Joaquin Valley, has been appointed General Superintendent with headquarters at San Francisco.

Mr. Ira C. Hubbell, heretofore Purchasing Agent of the Kansas City, Pittsburgh & Gulf, has been appointed Purchasing Agent of the Omaha, Kansas City & Eastern also.

Alexander Shields, Master Mechanic of the Chicago, Hammond & Western, has been appointed Master Mechanic of the Southern Indiana, with headquarters at Bedford, Ind.

Mr. J. A. Chisholm has been appointed Chief Engineer of the Mexico Cuernavaca & Pacific, with headquarters at the City of Mexico, in place of Mr. H. H. Filley, resigned.

Colonel William Crooks, heretofore Chief Engineer of the Minneapolis & St. Louis, at Minneapolis, has been appointed Chief Engineer of the Oregon Railroad & Navigation Co.

Mr. A. D. McCallum has been appointed Master Mechanic of the Cincinnati, Hamilton & Indianapolis division of the Cincinnati, Hamilton & Dayton Railway, at Hamilton, O.

Mr. J. A. L. Waddell, of Kansas City, Mo., has been appointed Consulting Engineer of the Boston Elevated R. R., and Mr. George A. Kimball, Boston, has been appointed Chief Engineer.

Mr. W. T. Godfrey, of the Oregon Short Line shops at Pocatello, Ida., has been appointed Master Mechanic of the Salt Lake & Ogden Railway, to succeed John Hurst, deceased. Mr. Godfrey's headquarters are at Salt Lake City, Utah.

Mr. J. A. Spoor, General Manager of the Wagner Palace Car Company, has been chosen President of the new company formed by a consolidation of the Union Stock Yards & Transit Company and the Chicago, Hammond & Western Railroad.

Mr. George F. Evans, General Manager of the Maine Central, was also chosen Vice-President of that road, at a meeting of the Directors, November 19. The position has been vacant since the retirement of Mr. Payson Tucker at the last annual meeting.

Mr. F. F. Fitzpatrick, for many years Chief Clerk to the General Manager of the Missouri Pacific Railroad, has resigned to accept the agency of the Charles Scott Spring Company, of Philadelphia, and has opened headquarters at Room 1402, Union Trust Building, St. Louis.

Mr. J. J. Conolly, heretofore Master Mechanic of the Duluth, South Shore & Atlantic, has been given the title of Superintendent of Motive Power and Machinery of that road. He has also been made Superintendent of Motive Power and Machinery of the Mineral Range and of the Hancock & Calumet Railroad Companies.

Mr. Harry W. Frost, who for a number of years has been identified with the business department of the *Railway Age*, has been appointed General Sales Agent for the Monarch Brake Beam Company of Detroit. His headquarters will be in Chicago. Mr. Frost has many friends and we join them in wishing him success in his new work. The Monarch Brake Beam Company is fortunate in securing such a popular and able representative.

Mr. W. S. Calhoun, whose services have recently been secured as Eastern Representative for the American Steel Foundry Company, is to be congratulated upon his new business relation and so is the company referred to. Men of Mr. Calhoun's ability are scarce and this concern could not have found a man for whom prominent railroad men have more respect. He was connected with the Chicago Tire and Spring Company for a number of years and is widely and favorably known. In his new position he will represent one of the best of the steel trucks, one that was designed by Mr. M. B. Schaffer, Master Car Builder of the Missouri Pacific Railway.

The Hon. Aretas Blood, of Manchester, N. H., died at his home in that city, November 24, aged 81. He was best known as the head of the Manchester Locomotive Works, incorporated in 1854 and with which he was identified until the time of his death. The Amoskeag Company was absorbed by the locomotive concern in 1872, and from that time fire-engine building became an important feature of the business. Mr. Blood's business career was very successful, and he held many positions in manufacturing enterprises. He had built up a considerable fortune and was known to have given liberally to many public and private charities. He was one of New Hampshire's best known citizens.

Dr. B. Kossmann, of Charlottenberg, has secured a patent covering a rust preventing paint composed of the peroxides of earths of the cerium group. The oxides in question, says the *Engineering and Mining Journal*, are incorporated with linseed oil varnish, to which is added as a drier a portion of linseed oil boiled with a mixture of boric acid and the peroxides. The resulting paint can be colored with graphite, lampblack, heavy spar, etc., and

is said to fulfill all the requirements exacted of such a composition, a sufficient oxygen content to insure the resinification of the linseed varnish and freedom from any metallic base capable of setting up an electrical action with iron, and so causing the formation of rust.

#### Books Received.

**STRENGTH OF MATERIALS.**—A Text Book for Manual Training Schools, by Mansfield Merriman, Professor of Civil Engineering in Lehigh University. 12mo, cloth; pp. 124. New York: John Wiley & Sons, 1897. Price \$1.

The author states in the preface that he has attempted to treat the subject of the strength of materials, beams, columns and shafts in a way that may be understood by those who have not the advantage of the calculus, and for this reason he used only the simplest of mathematical operations. The degree of mathematical preparation required is that now given in the higher grades of ordinary schools, such as high schools. The book was written specially for the students in the higher classes of manual training schools, and it was prepared with a view of rendering it easily comprehended by them, and at the same time cover all the essential principles and methods. At first glancing over the book we were inclined to take the view that such a task was too great for any writer, but on studying the work more closely we do not feel inclined to criticize it severely, because a student who carries out the intent of the work and who studies the subject by use of the numerical problems given cannot fail to get a good idea of the subject, even though he cannot bring the calculus to bear upon it. This may be considered as a case of Hamlet with Hamlet omitted, especially as regards the theory of beams, yet the book does not by any means give a mere smattering of the subject. It is a difficult thing to write such a book, and, considered strictly in the light of the object as outlined in the preface, it must be considered a success. An idea of the scope of the work may best be given by the following titles of the chapters: Elastic and ultimate strength, General properties, Moments for beams, Cantilever and simple beams, Columns or struts, The torsion of shafts, Elastic deformations, Resilience of materials and miscellaneous applications. A number of tables are given of elastic limits, tensile strengths, compressive strengths, weights of materials and constants.

#### SCRIBNER'S MAGAZINE FOR 1898.

The announcement by Messrs. Chas. Scribner's Sons, Publishers of *Scribner's Magazine*, shows that for the year 1898 an unusually valuable and interesting lot of articles has been arranged for, which will make this publication better this year than ever before, which is saying a great deal.

The story of the Revolution by Henry Cabot Lodge will be one of the leading features, of which the illustrations will form an important part. This is a large undertaking, the object of which is two-fold: to present a vivid picture of the Revolutionary War, reproducing the atmosphere and feeling of the time and avoiding the conventionally accepted text-book presentation. The other object is to show the historical significance of the effects of this war in a way which the author believes has not been appreciated. In speaking of the illustrations it should be mentioned that they will be prepared from sketches by well-known artists with a view of assisting in the effort to reproduce the atmosphere of the time. As a compliment to Senator Lodge's work, Capt. A. T. Mahan, U.S. N., will represent the influence of the American Navy in the Revolution, which will deal largely with the romantic side of the sea fighting of that war. Mr. Thomas Nelson Page will have his first long novel, "Red Rock," running through the numbers of the year, as the leading fiction serial. Mr. Walter A. Wyckoff continues his intensely interesting and very valuable articles, "The Workers," which during 1898 will have to do with the young author laborer's experiment in the West, where he had even more instructive experiences than those described in the series which appeared last year concerning his experiences in the East. A prominent feature of this series is to be a number of striking illustrations by Mr. W. R. Leigh, which will accompany each installment of the second part. Senator Hoar in his "Political Reminiscences" will record the observations made during his 45 years of public life. Robert Grant's search-light letters will be a popular feature again and those who have read the articles upon great businesses will look forward with interest to a continuation of these papers, to include "The Mine," "The Theater," etc. Among the other noteworthy articles will be three typical articles on "Bits of Europe in America," and "Life at

Girls' Colleges by Graduates." For short fiction, the work of Mr. Rudyard Kipling, Mr. Kenneth Grahame and Mr. George W. Cable may be looked forward to and the art features, including a number of studies of New York City by Mr. C. D. Gibson and Picturesque New York by Mr. Henry McCarter, promise to assist in making the volume attractive.

**STATUTES OF ILLINOIS RELATING TO RAILROADS AND Warehouses.** Rules of Practice and Rules Governing Crossings and Interlocking Cases. Published by the Railroad and Warehouse Commission, Springfield, Illinois. Paper 8vo, pp. 105.

The State of Illinois has its regulations for the construction of interlocking apparatus in the form of rules which are well known. The book before us contains these rules and also those for public hearings in cases involving the protection of crossings by interlocking appliances which are brought before the commission for decision.

**THE SCIENTIFIC PUBLISHING COMPANY** announces the completion of arrangements for the publication of a new illustrated weekly technical journal, *The Mechanical Engineer*, edited by Mr. William H. Fowler, whose name is a guarantee of a valuable and interesting paper. The list of names of authors already secured includes a number well known upon both sides of the Atlantic. The proprietors are The Scientific Publishing Company, Hodson's Court, Manchester, England.

**ANNUAL REPORT OF THE CHIEF OF THE BUREAU OF STEAM ENGINEERING, 1897.** Washington: Government Printing Office.

This report gives a statement of the appropriations for steam machinery, the general operations of the bureau, expenditures of money at the various navy yards and stations and an extended table showing the condition of each of the vessels of the navy. Valuable comments are offered on the following subjects: Water tube boilers, liquid fuel, the building of machinery and vessels in classes, the lighting of machinery compartments, machinery of ships in reserve, machinery plant for repair ships, steel inspection, personnel, enlisted men in the engineer department, and trials of new vessels. The report presents a favorable opinion of water tube boilers for war ships, but which is, withal, a satisfactorily conservative view. The lack of facilities for the proper training of men in the engineer's department is clearly shown, and the advantages of a training ship for these men are brought out. The careful and considerate study of the progress of steam engineering for war vessels which is reflected in this report, together with the evident watchfulness to permit no opportunity of improving the service to escape the bureau, gives assurance of the wide-awake condition of the department.

**PROCEEDINGS OF THE FIFTH ANNUAL CONVENTION OF THE NATIONAL RAILROAD MASTER BLACKSMITHS' ASSOCIATION, 1897.**

The principal subjects treated are as follows: The Master Blacksmith and his Duties, The Railroad Scrap Pile, Making and Repairing Springs, Locomotive Running and Valve Gear, Smith's Furnaces, Axle Making, Steel Axles, Machine Forgings, Case Hardening, Tool Steel, Track Tools, Locomotive Frames. The report is edited by Mr. A. L. Woodworth, C. H. & D. R. R., Lims, O., Chairman of the Executive Committee.

**PROCEEDINGS OF THE 28TH ANNUAL CONVENTION OF THE MASTER CAR AND LOCOMOTIVE PAINTERS' ASSOCIATION OF THE UNITED STATES AND CANADA**, held at Old Point Comfort, Va., 1897. Published for the Association by the *Railroad Car Journal*; New York, 1897.

This report gives the names of the officers and members of the association, the names of the committees and the proceedings of the recent convention. The volume is well printed and is bound in cloth (standard size). The work of the association is too well understood to require explanation to our readers. It covers the application of the art of painting to railroad rolling stock.

**ANNUAL REPORT OF THE CHIEF OF THE BUREAU OF CONSTRUCTION AND REPAIR TO THE SECRETARY OF THE NAVY**, for the fiscal year ending June 30, 1897. Washington: Government Printing Office, 1897.

**REPORT OF THE COMMISSIONER FOR RAILWAYS**, Queensland, Australia, for the year ending June 30, 1897. Brisbane, 1897.

**BULLETIN OF THE DEPARTMENT OF LABOR**, No. 13, November, 1897. Edited by Carroll D. Wright, Commissioner, Washington. Government Printing Office, 1897.

**LE MÉCANISME DU DIT FLUVIAL**, par V. Lokhtine, Ingénieur Voies de Communication, of Kazan. Translated into French by

A. M. Danzig, *Ingenieur des Ponts et Chaussees*, and edited by Du Bureau Technique International à St. Petersburg. St. Petersburg, 1897.

**REPORT OF THE SURGEON GENERAL U. S. NAVY**, Chief of the Bureau of Medicine and Surgery, to the Secretary of the Navy. Washington : Government Printing Office. 1897.

**MEMORIAL DE INGENIEROS DEL EJERCITO**. Fifty-second year, Vol. XIV., No. XI., November, 1897. Madrid, 1897.

**SIXTH REPORT OF THE BUREAU OF MINES OF ONTARIO**, 1896. Printed by order of the Legislative Assembly of Ontario. Toronto, 1897.

**IS THE INVENTIVE FACULTY A MYTH?** A pamphlet reprinted from *Cassier's Magazine*. 8 pp.

**PROCEEDINGS OF THE UNITED STATES NAVAL INSTITUTE**, Vol. XXIII. Edited by H. G. Dressel. Annapolis, Md., 1897.

**JOURNAL OF THE UNITED STATES ARTILLERY**. September and October, 1897. Published by authority of the staff of the Artillery School. Artillery School Press, Fort Monroe, Va.

**NINTH SPECIAL REPORT OF THE COMMISSIONER OF LABOR**. The Italians in Chicago, a Social and Economic Study. Prepared under the direction of Carroll D. Wright, Commissioner of Labor. Government Printing Office, Washington, 1897. 403 pp.

This report deals with the social and economic condition of the Italians in Chicago, and in it will be found valuable material for use in considering the question of immigration.

**HENRY CABOT LODGE**, Senator from Massachusetts, who is writing "The Story of the Revolution," for *Scribner's*, begins with a picture of the social conditions in Philadelphia in 1774, showing it to have been the most civilized city in the country at that period. Mr. Lodge is particularly strong in his characterizations of the great men of the time—Adams, Patrick Henry, Franklin, Washington.

#### Trade Catalogues.

An exceedingly attractive celluloid easel desk calendar for 1898 has been received from the Magnolia Metal Company. The calendar for each month is printed on a card held in a pocket and above this is printed matter in two colors devoted to the interests of the company. It is stated on the calendar that Magnolia Metal is in use by 10 leading governments.

**THE SARGENT COMPANY** has sent out a calendar for December which reached us too late for mention in our December issue. Upon it are shown a dozen pictures giving an excellent idea of the character and scope of the business of this company. Among the pictures relating to railroad work are several of the new "Diamond S" brakeshoe, and of steel wheel centers, such as are being furnished for Western railroads. The large steel gears recently cast are included in the illustrations of general machinery castings.

**STEAM BOILERS**, constructed by Yates & Thom, Canal Foundry, Blackburn, England. This is an interesting catalogue, which has for its primary object the illustration and description of the product of the works of Messrs. Yates & Thom, and for a secondary object it was intended to give engineers a lot of valuable information in regard to the present state of the art of English boiler construction and design. It is successful in both of these directions and is not unlike a number of the catalogues of the foremost of the American steam boiler manufacturers, except that it is more comprehensive. In addition to the illustrations of the boilers and appliances made by the company referred to there are a number of articles on the details of boiler construction with detail drawings of parts. The ordinary problems in boiler design are treated, including such subjects as boiler joints, furnaces, piping, steam separators, feed water heaters, the construction of chimneys and the prevention of smoke. The catalogue is from the pen of Mr. William H. Fowler, who is to be the editor of the new English paper, *Mechanical Engineer*. The price of the catalogue is five shillings. It is valuable as a book upon boiler practice and more money is frequently paid for less valuable treatises on the subject.

#### A Business Need Supplied.

There are few practical men of business who do not recognize the benefit of advertising in hunting new and holding old trade,

That many fail to show a proper appreciation of the fact by keeping alive an up-to-date and representative line of advertising is largely because to do so requires more time and attention than is available where those who must be entrusted with the work have already more than enough to occupy them. The need, too, of a master mind is an essential that is more than likely wanting in most instances. Not all of those who find themselves thus situated are aware that there is in existence in New York City a concern whose business is to supply to manufacturers the time and attention necessary for the efficient and profitable management of the advertising end of a business.

The Manufacturers' Advertising Bureau, 126 Liberty street, New York, supplies a business need. With the testimony of many of the largest and most prominent manufacturers at hand to back up the statement, we can say it is a thoroughly advantages business connection for the progressive but pressed-for-time advertiser of to-day. The firm that places its newspaper work and advertising in the charge of this Bureau will be relieved of the many vexatious time-taking but nevertheless necessary details that combine to make advertising pay, and will at the same time have the benefit of 20 years' experience in trade journal advertising.

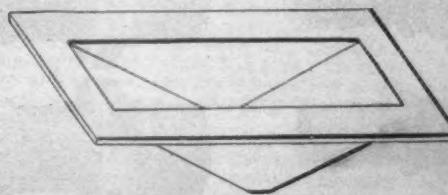
Mr. Benj. R. Western, the proprietor of the Bureau, is a thorough newspaper man of extensive experience in trade journal advertising. He has associated with him in the conduct of his business a corps of able assistants, qualified by experience to further in every way the interests of clients of the Bureau. The methods of the concern are such as the times demand. Their clients are well-served, and the number, we are pleased to note, is increasing every year.

A little book bearing the title "Advertising for Profit" is issued by the Manufacturers' Advertising Bureau, and tells in a brief busy man's way how Mr. Western and his associates work. Copies, we are informed, can be obtained gratis upon application accompanied by a business card.

#### A New Brazing Crucible.

A new or liquid process of brazing is threatening the old-time flame method. Several years ago it was demonstrated by a company formed for that purpose that a specially treated joint, plunged into molten spelter, would not only braze in a very few seconds, but would, in addition, come out almost entirely free from scale, a brisk cleansing by a metal brush being about all the after treatment required. The process was a secret one, the most important point being the anti-flux, which was a preparation painted over the parts to which it was desired the spelter should not adhere.

Briefly described, liquid brazing consists merely in reducing



A New Brazing Crucible.

the spelter to a molten form in a suitably shaped crucible at a high temperature, and then immersing the joint to be brazed in the liquid mass. The surfaces to be brazed are painted with a flux, and the adjacent parts with an anti-flux. A few months ago nothing definite was known regarding the best preparation for an anti-flux, each experimenter endeavoring to find out the best for himself, but the Joseph Dixon Crucible Company, Jersey City, N. J., placed on the market an anti-flux, known as Brazing Graphite, and repeated tests have demonstrated its value.

On account of the high degree of heat required, even the best of wrought-iron vessels possessed but short life under this treat-

ment. The Dixon Company, on account of its well-known reputation as crucible manufacturers, were therefore called upon to furnish some vessel that would successfully withstand the intense furnace heat. They have furnished several styles of graphite bowls, oblong crucibles, and other special styles, but have now manufactured a crucible specially adapted for this work. An outline sketch is shown above. It is 24 by 6 inches inside, the bottom forming an angle, being 10 inches deep in the middle. It has a 3-inch flange to support it in the furnace, and can be used in either coke, coal, gas or oil furnace. Further particulars will be furnished by the Joseph Dixon Crucible Company, Jersey City, N. J.

#### The Peerless Hose Nipple Cap.

The little device which is shown in the accompanying illustrations is one of the simplest improvements that have been brought out in connection with air-brake apparatus, but it is a very effective one and merits attention because its use will greatly prolong the life of air-brake hose. The object of the invention was to provide means for reducing the destructive effect of the cast iron

from 45 to 55 per cent. of the hose that is secured to the castings in the usual way.

Incidentally the cap furnishes a good packing at the joint, but it is the cushioning action for which the claims are made. The harsh edge of the iron is prevented from acting on the hose, and it cannot injure the cap. The cap does not in any way interfere with the action of the air-brake as has been demonstrated by the Westinghouse Air Brake Company, and the application of the caps is easy. The cap is coated with rubber cement, and the nipple or coupling is put on in the usual manner, as the resistance added by the presence of the cap is very slight. The cost is very low, and one of the best features of the cap is that it goes on any make of hose, no matter whether it is "cheap" or "good" hose. The Peerless Rubber Manufacturing Company, 16 Warren street, N. Y., has the sole manufacturing rights for the United States and patent's have been taken out in this and other countries.

#### The Garrison's Accident.

The conclusions of the State Railroad Commission regarding the cause of the New York Central wreck near Garrison's, on Sun-



The Peerless Hose Nipple Cap—By the Peerless Rubber Manufacturing Company.

nipples and couplings upon the hose at the ends of the castings. The engravings show the cap to consist of a ring of soft rubber folded internally at the end and cemented over a thin and narrow ring of brass, the office of the ring being to prevent the thin rubber lip of the cap from doubling up when put on the nipple or coupling. The cap, being of soft rubber, presents a yielding surface to the hose at the edge of the casting and prevents the cutting and wearing of the hose at that point which has been found to greatly reduce the life of the hose.

Mr. C. H. Dale, President of the Peerless Rubber Manufactur-

day morning, Oct. 24, whereby 18 passengers and three employees lost their lives, have been made public. The board, after an exhaustive investigation, which was conducted with the aid of expert engineers, is unable to determine the primal cause of the accident. In this respect each of the members of the Railroad Commission, Col. Ashley W. Cole, Frank M. Baker and Col. George W. Dunn, agree. The report says :

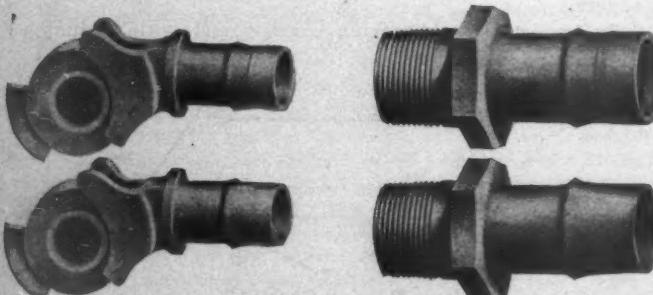
"Our final conclusions are that this train was wrecked either by derailment, which destroyed the embankment, or that the embankment gave way and threw the train into the river. Therefore the board feels it to be its public duty to recommend in urgent terms and to require that all railroads in this State whose roadbeds, or parts of roadbeds, are carried on embankments lying alongside of and washed by watercourses, shall give careful inspection to and provide constant and efficient maintenance for such embankments. Such care and supervision will do much to lesson, if not to abate wholly, one source of danger."

"This recommendation is not intended by the board, nor should it be regarded by the public, as expressing in any sense whatever belief that the accident which has been the subject of this inquiry and report was due, even secondarily, to a defective embankment. If this train was derailed it is doubtful whether any embankment, however rigid and sound, would have withstood such a shock if exerted directly against it. An expert engineer who testified before the board declared that the weight of this train, being all told 540 tons, moving at a speed of 40 miles an hour, its dynamic force or energy, if directed against a certain point, would be equal to 65,000,000 or 70,000,000 of foot pounds, or sufficient to have lifted the entire train 87 $\frac{1}{2}$  feet in the air. It is obvious that practically nothing but a mountain could resist such an impact."

#### Fads and Their Cost.

The members of the New York Railroad Club enjoyed a racy paper by Mr. R. P. C. Sanderson at the meeting held Dec. 16, and while the discussion brought out differences of opinion in regard to some of the suggestions it was clear that they nearly all struck home. We present the following extracts from the paper:

The object of this paper is to show that it is worth while to be



Westinghouse Couplings and Nipples, Showing Method of Application of Cap.

ing Company, is the inventor, and in investigating the cause of the failure of hose he ascertained that a large proportion, which he places at 90 per cent. of all the hose used, fails at the edge of the iron nipple connecting the hose to the train pipe. This is due to the bending of the hose against the iron in swinging. He has been working on the problem for several years and has only recently perfected the device to such a point that it is applicable to any hose and any nipple, as neither of these could be changed. Severe tests have been made by Mr. Dale, which show that the hose when protected with this cap may be expected to outwear

mean and stingy where the efficiency is not impaired thereby, and at the same time to give an idea of how the cents multiply into dollars. It is not for an instant supposed that every one of the savings later referred to can be effected by all of us, nor is there thought to be anything original about any of the items mentioned; they are simply selected for illustration. We can all doubtless find other items than these, some of us more and some of us less, according to the numerical value of the equipment, and the amount of attention that has already been given to the pennies, and to the amount of free hand we have in our own bailiwicks.

Owing to the continual loss of nuts off archbar and box bolts, it was proposed to use only one nut on these bolts with a split key under the nut. The cast washers commenced breaking by the hundreds, the pieces fell out, the archbars bent and broke. The remedy at once proposed was to use malleable or wrought washers. All things considered, wrought washers were best, and thousands of them were stamped out of scrap under the steam hammer. Most careful investigation showed that the reason why the cast washers broke was because they were not flat, but had fins and small nubbins on their sides, and also because of the springing of the archbars—by simply turning them upside down so that the rounded sides come against the archbar, the cast washer stands without breaking and saves 92 cents per car.

For the 1,900,000 freight cars in the United States and Canada this would equal \$1,172,000.

A cylindrical 16-inch stack with a modest curved cast-iron top and not too ornate cast base, with Russia iron casing and a choke inside, costs, complete, about \$15.51. A cast smokestack complete, weighing 520 pounds, can be produced for from \$3 to \$4, showing a maximum saving per engine of about \$11.51. For the 35,800 locomotives in the United States and Canada this would mean \$412,058.

When the railroads of America began to realize that the old familiar diamond stacks must go there was choice of two prototypes of front ends of engines, one known as the Smith, the other as the Hill. The former had no extension and cleaned itself; the latter had an extension and was expected to retain the cinders. It became "the thing," and has cost the railroads millions of dollars for cleaning out cinders at terminals and between terminals, as well as for loading, transhipping and disposing of the cinders. All this could have been saved without any offsetting disadvantages or costs if the Smith front, which cleaned itself, had become the thing instead of the Hill. It is estimated that 25 cents per 100 engine miles would approximate the total cost of cleaning the cinders out of the fronts, loading them, hauling them away and dumping them, which would represent over \$2,500,000 per annum. This does not include the additional first cost of the extension front, which would come to about \$14 per engine, or \$501,200—five per cent. interest would equal, per annum, \$25,060.

Combustion chambers have their uses and merits in stationary and marine boilers of certain kinds and sizes, but to shorten the flues of a locomotive boiler from 6 to 14 inches, to introduce separate flue and flanged throat sheets, with the concomitant endless troubles, sacrificing at the same time 100 or so feet of valuable heating surface, all to get a 6 or 14 inch space in the front of the firebox for "combustion chamber" purposes seems like carrying a far a little too far.

It has been a custom from the first to use semi-elliptic springs for carrying the weights of our locomotives on the driving boxes. How much more ease of motion is there in a 30-inch semi-elliptic having 24 to 26 leaves  $\frac{1}{8}$  inch thick and  $3\frac{1}{2}$  inches wide, and costing close on \$10, as compared with a pair of coil springs of the same capacity costing, perhaps, 70 cents? The extra cost would represent nearly \$2,502,500, the interest on which at five per cent. per annum would be \$125,125. A similar argument could be used with regard to tender truck springs, where the net saving would mean \$1,656,824.

There is no longer any good purpose in putting headlights of the size of a small Saratoga trunk on the front of engines. All that is really needed is a front signal lamp of a distinctive character. There is a positive danger in using a very brilliant and powerful headlight, such as some of our electric friends are interested in, for the reflected glare off the surface of the switch lamp lens is often so great that it entirely overpowers the light coming from the lamp, and will show apparently white light to the engineman while the signal may be standing at red or green. For safety a runner must therefore look for the position of a target or semaphore and not trust to the lights at night. According to the nature of the country through which a railroad runs, a saving of from \$6.50 to \$10.50 per engine can be effected by using a 16-inch or a 12-inch headlight instead of a 28-inch headlight.

Can anyone defend the practice, now becoming gradually obsolete, of fancy painting and gilding of locomotives? A modest legend of 15 letters, giving the name of the road on each side, would cost for gold leaf and labor \$4.60; in chrome yellow paint the labor and material would cost \$1.50.

The painting, lining, striping and varnishing of passenger trucks will cost \$7.40 per car. Two good coats of paint applied without decoration or varnishing cost \$2.20 per car.

The inside rubbing down of the varnish to an eggshell gloss costs for labor \$11.40 per car. A light rubbing down with one fifth benzine and four-fifths raw oil slightly deadens the brush gloss of the new varnish, producing a very fair representation of the eggshell gloss, and can be done for \$1.70 per car. While if the brush finish were left undisturbed, none but trained eyes would notice the difference, and it is safe to affirm that of those who did notice it not one would change his route on this account.

The statistics of our railroad accidents certainly do not show that good chilled wheels are unsafe, or that steel-tired wheels are any safer for the present average passenger car-wheel loads, and there does not seem to be any good reason why railroads should charge their equipment accounts with from \$280 to \$418 per car for steel-tired wheels, and burden their maintenance of car accounts with the cost of tire turnings and renewals.

The pressed steel trucks were a big improvement over some

freight trucks, but that does not necessarily imply that they are better than all archbar trucks, and they certainly are an increased source of expense when renewing wheels; besides, when bent up in a mishap, are practically unrepairable at the ordinary railroad shop, and can only be scrapped, unless the shops are provided with formers and presses to reset them after the parts are cut apart. Now, a good all-steel diamond truck with double 8-inch eye-beam blocked bolster, steel spring channel, steel brakebeams with inside-hung brakes, malleable center plate and side bearings,  $4\frac{1}{2} \times 8$  inch M. C. B. axles and 600 pound wheels, which cost just as little for running repairs as the pressed steel truck, and cost a great deal less in case of accident repairs, can be built for \$74.50 per truck, including all material, all shop labor, uncharged time and supervision. Such being the case, we ought to stop to think several times before increasing the cost of our cars about \$70 each for pressed steel trucks; this amount would very nearly pay for an outfit of air-brakes and couplers for the car and help the railroad company to comply with the terms of the Railway Safety Appliance Act.

It has been a fashion in some parts of the country to stencil the freight cars with 30 to 36 inch letters and figures, as if the conductors and yardmen were in the habit of standing off a quarter of a mile when taking numbers. If those who stencil cars in this way had to run along a train of 35 cars on a dark night between the tracks in the yard, taking initials and numbers, they would very soon resort to the use of small letters and figures grouped close together where the light of a hand lantern would cover them all at once, and so that the eye can at short range take them in at one glance at daylight or dark, instead of having to run up and down all the way along a 34-foot car to have to read four or five initials and four or five numbers. The large stenciling for about five letters and five figures repeated on both sides of the car costs for white lead and labor, 76 cents. The same number of 6 or 7 inch letters and figures grouped together would cost 34 cents; difference in favor of small stenciling per car, 42 cents. If this could be saved for all the 1,190,000 freight cars in the United States and Canada, it would mean \$499,800.

Now, if we assume that freight cars require restenciling once every four or five years, this would represent an annual outlay of \$99,960 spent on the fad of large lettering, without counting interest.

The little red caboose behind the train is commonly painted with vermillion, or a cheap imitation thereof, because it is to be considered as a danger signal, and bright red is the danger color. To be consistent we should paint the front ends of our locomotives a very bright scarlet, and the ends of all passenger, Pullman and freight cars the same color. Our bright red caboose is just as brown as a common freight car after two or three months running, but remains just as dangerous to run into in spite of having lost its brilliancy. The two months that the red imitation vermillion stays at danger color costs us \$6.40 per caboose, instead of \$1.65 for brown paint, the difference being \$5.75 spent on a bright red fad.

In presenting this paper the writer, in conclusion, will ask the members to consider that it is the result of hard times and not to think the spirit of it is simply iconoclastic.

#### Fast Runs on the Union Pacific.

Some remarkably fast runs have been made upon the Union Pacific Railway recently and they appear to be rather a common occurrence. On November 28 the Fast Mail made a run concerning which Mr. J. H. McConnell writes us as follows:

The train was delayed six hours at Medicine Bow, Wyo., on account of a bridge burning out. On arrival at Cheyenne, Wyo., it was decided to run the mail in order to reach Council Bluffs, Ia., in time to avoid paying the fine which is imposed by the Postal Department, according to the terms of the contract under which the mail is carried, when connections are not made with Eastern lines. There was no special preparation made for this run; the engines were our regular passenger engines and were selected in their turn out. The train left Cheyenne 5 hours and 28 minutes late and arrived at Council Bluffs 40 minutes late, having made up 4 hours and 48 minutes. The distance run is 519 miles and the time occupied on the run was 557 minutes, which includes all stops and slow downs.

Engine 1813, with two mail cars, left Cheyenne at 7:28 a. m., mountain time, arrived at Sidney 9:15 a. m.; 102 miles in 107 minutes.

Left Sidney at 9:21 a. m., engine 841, arrived at North Platte 11:19 a. m.; 123 miles in 118 minutes, stopping two minutes at Julesburg, Colo., for mail from Denver.

Left North Platte 12:23 p. m. (central time), engine 816, arrived at Grand Island 2:57 p. m.; 137.5 miles in 157 minutes. Delayed at Lexington 3½ minutes taking water and changing engineers; Engineer White making the run from Lexington to Grand Island, 77½ miles, in 80½ minutes, making one stop at Kearney.

From Grand Island to Council Bluffs, 156.2 miles, engine 800 left Grand Island at 3:02 p. m., arrived at Columbus at 3:55 p. m., 62 miles in 53 minutes; delayed 5 minutes fixing tank-hose and taking water. Left Columbus at 4 p. m., arrived at Fremont 4:42, 45 miles in 42 minutes; left Fremont, 4:44, passed Valley, 11 miles, at 4:55, passed Gilmore, 36½ miles, at 5:28½, passed Omaha 5:40, arrived at Council Bluffs 5:45 p. m., 15 minutes ahead of the leaving of eastern mail from Council Bluffs.

The 100 miles between Grand Island and Ames were made in 88 minutes, including the stop of 5 minutes at Columbus. There was delay of 3 minutes at Millard, 4 at Portal, and slow time from Gilmore to South Omaha, and between South Omaha and Council Bluffs.

This is a noteworthy performance when it is considered that the decision to make a fast run was not premeditated. It is a fact that the grades favored the speed. There is a difference of eleva-

tion of 7,030 feet between the terminals of the run, Council Bluffs being the lower. The speed in this case averaged 50.7 miles per hour from the start to the finish.

The engines referred to belonged to three classes, of which the chief dimensions are as follows:

DIMENSIONS OF LOCOMOTIVES.

	Engine Numbers.		
	1813	841 and 816	800
Type	10-wheel	8-wheel	8-wheel
Cylinders, diameter	in. 20	18	19
" stroke	in. 24	26	24
Steam ports	in. $17 \times 1\frac{1}{2}$	16 $\times 1\frac{1}{4}$	17 $\times 1\frac{1}{2}$
Exhaust	in. $17 \times 3$	16 $\times 2\frac{1}{2}$	17 $\times 3$
Travel of valve	in. 5 $\frac{1}{2}$	5 $\frac{1}{2}$	5 $\frac{1}{2}$
Lap of valve	in. 5 $\frac{1}{2}$	5 $\frac{1}{2}$	5 $\frac{1}{2}$
Lead in full gear	in. 16	15	15
Diam. driving-wheels	in. 60	60	60
Driving-axle journals	in. 8 $\times 11$	8 $\times 11\frac{1}{2}$	8 $\times 11\frac{1}{2}$
Truck-axle journals	in. 5 $\frac{1}{2}$ $\times 10$	5 $\frac{1}{2}$ $\times 10$	5 $\frac{1}{2}$ $\times 10$
Firebox, length inside	in. 108	72 $\frac{1}{2}$	96
Firebox, width inside	in. 32 $\frac{1}{2}$	33 $\frac{1}{2}$	31 $\frac{1}{2}$
Heating surface	sq. ft. 1,955.50	1,347.6	1,688.9
Grate area	sq. ft. 24.56	16.71	22.8
Weight of engine	lbs. 131,200	107,000	119,600
Weight on drivers	lbs. 103,400	69,300	81,025
Weight of tender empty	lbs. 45,900	45,900	45,900
Capacity coal	gals. 28,000	28,000	28,000
" water	gals. 4,000	4,000	4,000

TRAIN WEIGHTS

Cheyenne to Sidney.

	Pounds.
Engine 1813 and tender, with coal and water.	238,433
Train, two mail cars, 60 feet, with load	192,000

Cheyenne to Sidney, total engine and train..... 430,433

Sidney to North Platte.

	Pounds.
Engine 841 and tender, with coal and water	214,233
Train	192,000

Sidney to North Platte, total engine and train..... 406,233

North Platte to Grand Island.

	Pounds.
Engine 816 and tender, with coal and water	211,033
Train	192,000

North Platte to Grand Island, total engine and train..... 403,033

Grand Island to Council Bluffs.

	Pounds.
Engine 800 and tender, with coal and water	226,833
Train	192,000

Grand Island to Council Bluffs, total engine and train..... 418,833

We stated that several fast runs had been made. On Dec. 4 the fast mail ran from Sidney to Grand Island, 261 miles, in 238 minutes, or at the rate of 65.6 miles an hour. From Kearney to Grand Island, 42 miles, the time was 36 minutes, or 70 miles an hour. On the next day a special theatrical train ran from North Platte to Council Bluffs, 294 miles, in 286 minutes. This train was delayed at the crossing at Portal, which, with the regular stops, made the rate of speed while running 64.1 miles an hour.

On Dec. 10 the fast mail ran from Cheyenne to North Platte, 225 miles, in 214 minutes, at the rate of 68.1 miles an hour. On the first part of the trip, Cheyenne to Sidney, 102 miles, the time was 97 minutes; the second part, from Sidney to North Platte, 123 miles, consumed 117 minutes.

The Player Metallic Truck.

Among the metallic car and tender trucks to attract attention recently are the designs by Mr. John Player, Superintendent of Machinery of the Atchison, Topeka & Santa Fe Railway and made by Messrs. Shickle, Harrison & Howard of St. Louis. We show the construction of the freight truck in the accompanying engravings. These trucks are very much alike, the chief differences being due to the fact that coil springs are used on the freight truck and elliptic springs on the tender truck. The bolster and transoms are of cast steel and the side frames are of the diamond type.

The weight of the transom is 550 pounds, and that of the bolster is 350 pounds, including the side bearings. It will be seen from the drawing that the springs may be removed very easily from the ends of the bolsters upon raising the bolsters by means of jacks. The castings are of open-hearth steel, and as there can

be but little wear upon the parts, they should last a long time in service. Fig. 1 shows the construction of the freight truck.

Through the courtesy of Mr. Player and also of Mr. Willis C. Squire, Mechanical Engineer in the Motive Power Department of the road, we have received a copy of the results of the tests of the bolsters by Mr. Squire, and they are of special interest.

In the tests it was desired to subject the two members of the truck, the frame and the bolster, to the same strains as would be encountered in service; that is, to arrange the parts so that the load would be carried on the points or surfaces that were designed to carry them.

The first tests were made on the tender transom and bolster. The arrangement of the parts for the tests is shown in Fig. 2. The bolster was placed on the center plate and resting on the upper head of the testing machine. The spring pockets were filled by wrought-iron filler blocks and upon these the transom was placed. This arrangement brought the parts into the same relative positions as in practice, except that the whole com-

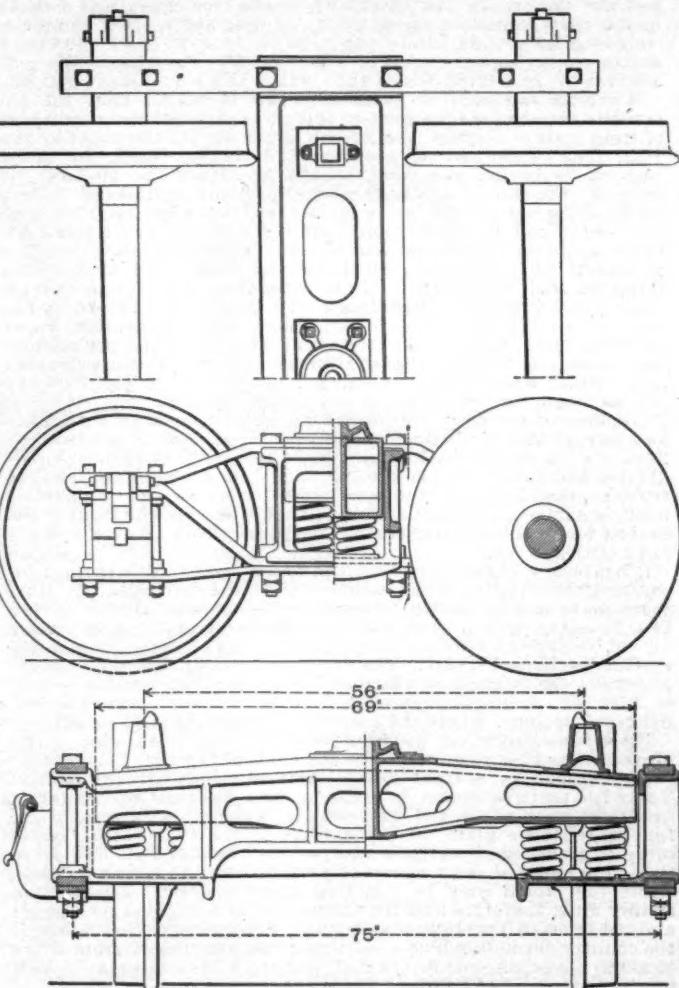


Fig. 1.—Construction of the Player Truck.

bination was inverted and carried on the center plates. Yokes were hung in the arch bar guides and the load was applied through them by the movable head of the machine. The capacity of the machine is 200,000 pounds. The tests were elaborate and the report gives evidence of very careful work both in the planning and in the execution. It is, in fact, the most comprehensive test of this kind that has come to our attention. We shall be able to present only a brief summary of the results in the space at command.

In the tests an initial load of 10,000 pounds was used in order to bring all of the parts to a solid bearing. The readings of the deflections were taken with micrometer and vernier calipers, using electric contacts to ring a bell for the purpose of avoiding the possibility of error due to the springing of parts in taking the measurements. Fig. 2 shows the methods of measuring elonga-

tions. The deflections were all plotted in curves, and these indicate that the elastic limit of the transom and bolster when taken together is about 145,000 pounds. This would give a factor of safety of more than two before the elastic limit is reached under a load of 50 tons on both trucks. The results show the elongation of the frame for a load of 155,000 pounds to be 0.082 of an inch in the bottom and 0.007 in the top of the frame, and in subsequent tests it was found that there was no permanent set in this respect even under loads of the full capacity of the machine, 200,000 pounds.

Tests of the tender bolster alone showed the elastic limit to be about 155,000 pounds and at a load of 150,000 pounds the deflection was but one-quarter of an inch. Under a load of 180,000 pounds the deflection of the bolster was 0.412 inch. The top

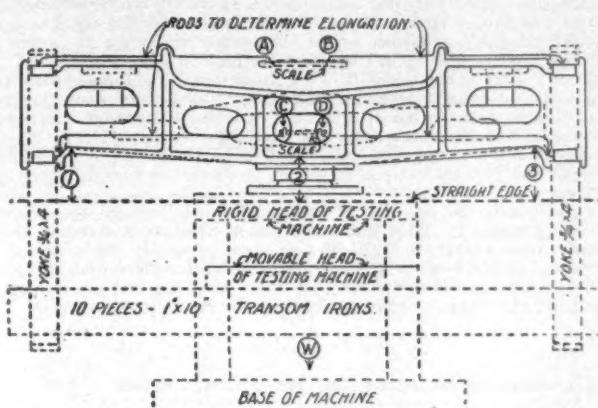


Fig. 2.—The Method of Testing Tender Bolster and Transom.

view of Fig. 3 shows the deformation of the bolster, the dotted lines showing the outline before the loading.

The freight car truck frame, being identical in form with the other frame, it was not tested. The freight car bolster was tested and it was thought desirable to change the locations of some of the openings in order to strengthen it, though it was not considered really necessary to do so. The outline of this bolster before and after loading is shown in the lower view of Fig. 3. The maximum total load on the freight bolster was 166,200 pounds and the deflection was 0.939 inch. The tests as a whole prove

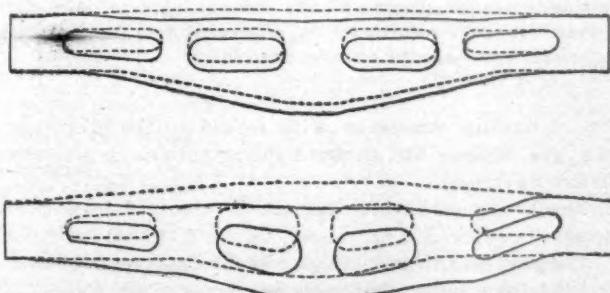


Fig. 3.—Distortion of the Bolsters in Tests.

the construction to be a very strong one, one of the best features being the fact that no two parts of the bolster gave way at the same time and the final yielding was so gradual as not to cause uneasiness in regard to accidents on the road.

The metal of which the bolsters were made showed a tensile strength of 66,800 pounds per square inch. Bending tests also gave satisfactory results and developed the fact that the material might be expected to fail, if at all, after the manner of wrought iron.

Comment upon these figures is entirely unnecessary. The design and the material appear to be equally good. These bolsters and the transoms show an excellent distribution of the metal and the combination is a strong one. It is regretted that data are not available for comparisons with other types upon this basis. It should be stated that the length of the bolsters, both for cars

and tenders, is 68½ inches, while the distance between side bearings on the tender bolster is 53 inches and on the car truck bolster it is 56 inches.

#### The B. & O. Service to the Klondike.

The railroads expect a rush of travel to the Klondike in the spring. It is estimated that a great many people will attempt to reach the goldfields as soon as the winter is over, and with a desire to turn a nimble penny at every opportunity trunk lines are beginning to prepare for the expected rush.

One of the first in the field is the Baltimore & Ohio Railroad— which will on Tuesday, Dec. 21, begin the running of the through tourist car from New York City to San Francisco without change by way of Philadelphia, Washington, Parkersburgh and Cincinnati, reaching St. Louis Wednesday evening, Texarkana Thursday afternoon, El Paso, Texas, Friday evening, and San Francisco Sunday morning.

This service is in addition to the one provided by the Baltimore & Ohio Railroad from Pittsburgh by way of Cincinnati and the Illinois Central to New Orleans and the Southern Pacific through to the coast, the Pittsburgh car leaving every Wednesday. The New York car on its return leaves San Francisco Monday evening and the Pittsburgh car leaves on Thursday.

#### The "Composite" and its Field.

The "Composite" or steam motor car of the New England Railroad was illustrated and described in our November issue of last year (page 362), and on page 382 of that issue, under the caption, "The New Problem in Transportation," we outlined the reasons for its design and expressed the opinion that its field was large and important. Mr. C. Peter Clark, General Manager of the New England Railroad, read a paper upon this subject at the meeting of the New England Railroad Club Dec. 14, from which we reproduce the following paragraphs:

Even in New England, with its dense population, the public demand for increased service has for the past 10 years resulted in such additional passenger train mileage as equaled, and in many cases outstripped, the increase in earnings. In other words, the average number of passengers using each train is no more than 10 years ago, despite the natural increase in population. With 16.6 per cent. of the steam railroad mileage of this country now or recently in the hands of receivers, an increasing demand for more expensive service, and with competition from trolley lines furnished with a right of way at the public expense taking the business of the steam railroads *only* where it is profitable and leaving the existing carriers to serve the public where the business must be done at a loss, the present situation certainly seems to justify careful examination.

During the year ending June 30, 1897, the number of passengers carried in and out of Boston shows an actual decrease over the previous period of 12 months, which amounts to a loss of nearly 4,000,000 passengers, or seven per cent., while the number of people transported by the West End Street Railway System, with its numerous suburban lines, shows an increase of 5,500,000 passengers. The past year has seen an application of electricity to the steam track of the New England Railroad between Hartford and New Britain—about 10 miles. The service between the two places was practically doubled, but arranged at a uniform interval of 30 minutes. No baggage was taken and the fare established at 10 cents, a reduction of substantially 45 per cent. The business increased over threefold.

There are many places where similar increases in business might be expected, but even that increase of business in most localities would not warrant the necessary capital outlay for electrical equipment.

An adequate power-house, conductor and machinery will demand an outlay which will require for interest at six per cent. and depreciation enough annually to pay the interest on the value of a passenger locomotive and leave enough to pay for all the coal which it would need to pass over the line one way each hour 12 times a day. The labor cost of running the locomotive would manifestly be less than the combined expense of manning the motor and power-house, besides saving the entire fuel cost of the generating plant. But if a service every 15 minutes is needed the interest would figure but a small fraction of the locomotive fuel per mile, and even this will be much further reduced by running the plant seven days a week, more than 15 hours a day, and if the house has been well placed the chances are that additional lines radiating in other directions will contribute further economical results.

There is evidently little or no economy to be expected from electricity under such conditions as have been assumed, unless the business justifies more than an hourly service, and as this is seldom the case away from large places electricity, like compressed air, promises no improvement in the cost of operation, and we remain dependent upon the locomotive for the majority of our territory.

Let us examine the passenger-train loads by dividing the number of passengers carried one mile by the number of passenger-train

miles run by the roads terminating in Boston. We thus obtain an average passenger-train load for the

	Passengers.
N. Y., N. H. & H. ....	73
Boston & Albany.....	70
Boston & Maine.....	59
New England.....	47
Fitchburg.....	47
B., R. B. & L. ....	43

No road in the country exceeds in passenger business per mile the Boston & Albany and New York, New Haven & Hartford roads. It therefore appears that the average number of passengers carried in one train upon the best passenger roads in the country could be sealed in one of their largest coaches.

If the average gross weight of trains on the New England Railroad is distributed among the average load of 47 passengers the present method of locomotives shows about 7,500 lbs. dead weight moved for the accommodation of each passenger.

A statement of the passengers carried upon the various passenger trains of the New England road preliminary to a new time-table, and for the purpose of disclosing the average number of passengers carried upon the different trains, located about 325,000 passenger-train miles per year, carrying less than 25 passengers each, some averaging as low as six. While the obligation of the company to

made in less than 500 feet on level track, with no suggestion of inconvenience to those standing in the car. [Our engraving shows three starts and stops made by the car, the last of which is the one referred to here. The horizontal distance is divided into three separate miles.—ED.]

The composite car can be turned on a common wooden table furnished with ordinary wheels. Of course, the most expeditious and satisfactory way where land is obtainable, is to lay a small loop or "Y." The present composite will easily run around a loop of 200 feet radius.

The best record for speed thus far attained is a mile in 61 seconds or 59 miles an hour. This requires 472 revolutions of the 42-inch drivers every minute. The longest runs which have been taken are between 100 and 120 miles.

The water carried will last about 50 miles on fairly level track, and the coke bin carries fuel enough for a 100-mile run. The machine has ample power to haul at least one passenger, coach, and in an emergency was called upon to move 11 freight cars, which was done without apparent effort.

The service application of the brake upon a level track gives a comfortable stop from 40 miles an hour in less than 500 feet, while a stop made entirely by the conductor's valve in the rear compartment of the car, with the throttle wide open and the reverse lever in usual running position, speed indicator showing 27 miles an hour, resulted in a stop in less than 250 feet in 14 seconds.

Not only does the composite with these qualifications appear able to cover all mileage where the maximum number of passengers to be handled is within its limits, but possibly increase the gross revenue, and at the same time net earnings, by permitting the subdivision of some trains at present self-sustaining, but which do not represent the full travel which might be developed by a more frequent service.

The composite car has run 12 miles without having the door of the firebox opened. This indicates little need of a fireman if the engineer upon a private right of way can properly be allowed as much responsibility as is placed upon a motorman operating the heavy electric cars in city streets, with nothing but hand-brakes, and among the teams, crossing numerous blind street corners.

#### Locomotive Building in the United States—1897.

From the statements received from the locomotive building firms of the United States covering the number of locomotives built during the year 1897 it appears that a total of over 1,000 have been built. We have not received the returns from two firms, which would probably increase the number to about 1,100. The seven most prominent builders report a total of 1,052 locomotives, of which 225 were for export.

Of those built for domestic service 271 are of the eight-wheel type, 282 have three driving axles and are of the mogul and 10-wheel types, 92 are of the consolidation type, four are of the six wheel connected type, 15 are of the 12-wheel type, 88 are switchers and others are of miscellaneous types.

As 1897 must be considered an off year as regards the building of new equipment the record is satisfactory. It would be equally interesting to examine figures for the number of cars built during the year, but as the returns are not all available at this time it will be impossible to state the number until later.

The following statement with regard to the advantages of using gas engines for electric lighting purposes is given by *La Lumière Electrique*:

1. The facility with which gas can be obtained from existing sources.
2. The gasworks themselves may be used as a central station.
3. It has been shown that one cubic meter of gas gives—
  - (a) In an ordinary gas burner of 16 candle power, a maximum of 91 candle hours.
  - (b) In an incandescent electric lamp, a minimum of 162 candle hours.
  - (c) In a Wenham lamp, a maximum of 200 candle hours.
  - (d) In an arc lamp, a minimum of 654 candle hours.
4. If the electric lighting were carried out by the gas company, a smaller staff will be needed than in the case of an independent company, with which the advantages of combining both systems of supply, thus obviating competition, should be considered; and further, the gas supplied to the engines would, under these conditions, be obtained at the cost of production, and not at the selling price.

Mr. A. Zdzarski has recently been appointed Assistant Chief Engineer of the Great Siberian Railway, with headquarters at St. Petersburg, Russia.

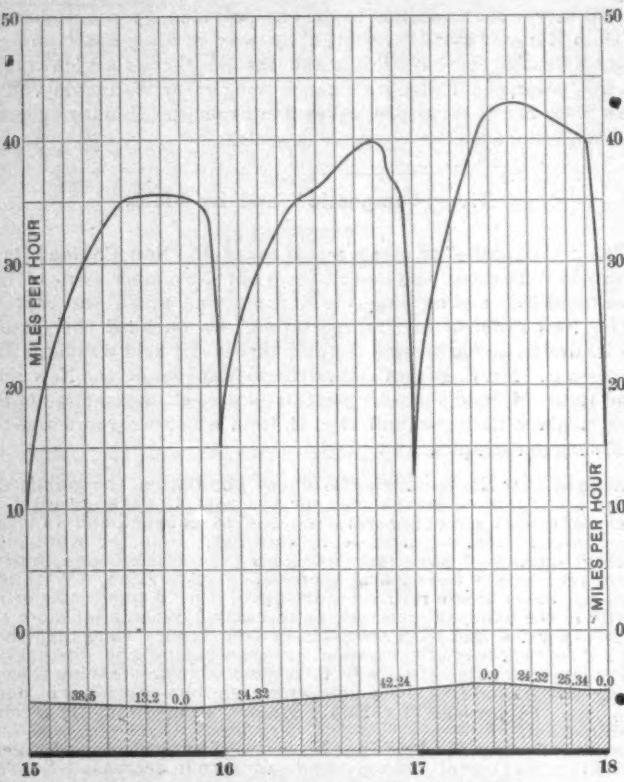


Diagram of Three Stops One Mile Apart.

transport was recognized, the great loss of money in connection with this transportation naturally received careful attention. That public convenience would not admit of any substantial reduction in service was evident upon examination of each individual case. The necessity of reducing expenses was apparent and urgent, the property not having paid any dividend for six years.

Inquiry failed to suggest a vehicle suited to the conditions. If the steam locomotive must be run, it should be one capable of working economically, with a burden suitable for the transportation of not over a carload of passengers. These conditions suggested the old steam dummy, and an examination of one of the number manufactured for street service about 20 years ago was made. The limited speed at which it could comfortably travel was certainly against it, and the extremely disagreeable rocking and swinging motion caused by the excessive overhang of car body, aggravated by the reciprocating motion from the cylinders connected to the sides of the car, gave little encouragement in this direction. While the whole subject was in this indefinite condition, the President and Vice-President of the Schenectady Locomotive Works took up the question, which resulted in the building of the composite car. [The work was done, as we understand it, by consultation with Mr. Clark.—ED].

The Reagan water grate, similar to that used on the *Paris*, was adopted, and is giving good satisfaction. A slight movement of a handle behind the engineer's seat is all that is necessary to furnish a fresh fire over the entire grate surface, no poker or other tool being required for either coke or anthracite. The fuel now used is coke.

The boilers are fed by two Hancock inspirators, the smaller of which is practically allowed to work without interruption. The Westinghouse quick-acting brake is used on all wheels, and in connection with the so-called "Composite" brakeshoe containing seven cork inserts, gives a most satisfactory and finished braking power. A service stop from a speed of 40 miles an hour is easily

## Consolidation Locomotive—Mexican Central Railway.

It will be interesting to compare the dimensions of the large freight engines for the Mexican Central Railway, illustrated in our issue of November, 1897, page 371, with another design by the same builders, the Brooks Locomotive Works, which is somewhat lighter and of the consolidation type. Ten of these consolidation engines have been built, and the general appearance is almost identical with the heavier type, except that the trailing wheels have been omitted. The chief dimensions of the new engines are as follows:

Gage.....	4 feet 8½ inches
Fuel.....	Coal or wood
Weight on drivers.....	100,000 pounds
" truck wheel.....	20,000 pounds
" total.....	180,000 pounds
" tender, loaded.....	90,000 pounds
Heating surface, firebox.....	204 square feet
" tubes.....	2,140 square feet
" total.....	2,344 square feet
Grate area.....	31.5 square feet
Wheel base, of engine.....	23 feet 5 inches
" driving.....	15 feet
" total.....	60 feet 9¾ inches
Length over all, engine.....	35 feet 2 inches
and tender.....	59 feet 7 inches
Height, center of boiler above rails.....	9 feet 2 inches
" of stack.....	15 feet 4½ inches
Drivers diameter.....	57 inches
" material of centers.....	Cast steel
Truck wheels, diameter.....	28 inches
Journals, driving axle.....	8½ inches diameter by 11 inches
" truck.....	5 inches by 10 inches
Main crank pin, size.....	6½ inches diameter by 8½ inches long; coupling, 7½ inches diameter by 5 inches long
Cylinders.....	21 inches by 26 inches
Piston rod, diameter.....	4 inches
Steam ports, length.....	18½ inches
" width.....	1½ inches
Exhaust ports, length.....	18½ inches
Bridge, width.....	.3 inches
Valves, kind of.....	Richardson balance
" greatest travel.....	.04 inch
" outside lap.....	.1 inch
" inside lap.....	Line and line
" lead in full gear.....	Line and line
Boiler, type of.....	Player improved Belpaire
" steam pressure.....	180 pounds
" thickness of material in barrel.....	Steel
" diameter of barrel at smokebox.....	11, 12, 14, 16 inches
Seams, kind of horizontal.....	Sextuple riveted lap
" circumferential.....	Triple riveted lap
Thickness of tube sheets.....	½ inches front, ½ inches firebox
" roof sheet.....	½ inches
Crown sheet stayed with.....	Improved direct stays
Dome, diameter.....	31½ inches
Firebox, length.....	120 inches
" width.....	37½ inches
" depth front.....	80 inches
" back.....	73 inches
" material.....	Steel
" thickness of sheets.....	Flue, ½ inches; crown, ½ inches; sides and back, ½ inches
" mud ring.....	4 inches thick, double riveted
" water space, width. Front, 4 inches; sides, 4 inches; back, 4 inches.....	37½ inches
Tubes, number.....	Iron No. 12 B. W. G. thick
" material.....	2 inches pitch 2½ inches
" outside diameter.....	11 feet 1½ inches
" length over sheets.....	4,500 gallons
Tender, tank capacity for water.....	9 tons
" coal capacity.....	1½ tons
Thickness of tank sheets.....	½ and ¾ inches
Type of under-frame.....	9 inch channel steel
Type of truck.....	" Robinson" rigid bolster
Diameter of truck wheels.....	38 inches
Axle journals.....	4½ by 8 inches

The wheel centers were made by Pratt & Letchworth, the tires by Krupp, the sight feed lubricators and the injectors by the Nathan Manufacturing Company, the brakes by the Westinghouse Air Brake Company, the springs by the Charles Scott Spring Company and the Le Chatelier water brake by the Brooks Locomotive Works.

## Reduction in Cost of Steam Power from 1870 to 1897.\*

BY F. W. DEAN.

In the year 1870 the most economical steam engine in use in mills was the Corliss simple condensing engine which used 19 or 20 pounds of steam per horse-power per hour. Previous to that time compound engines had been used in England in mill practice, and simple engines had in many cases been changed to compound.

The Pawtucket pumping engine, built by George H. Corliss, and started on June 30, 1878, is another important example of economical pumping engines, and probably was the most economical steam engine which had been built up to that time, having used less than 14 pounds of dry steam per indicated horse-power per hour.

\* From a paper presented at the New York meeting (December, 1897) of the American Society of Mechanical Engineers.

In 1873 the most economical compound engines used about 16½ pounds of steam per indicated horse-power per hour, as shown by tests of the Lynn and Lawrence pumping engines, which then established new records for duty. Improvements in methods of using steam were made until it is now as easy to design an engine to use less than 13 pounds of feed water per horse-power per hour as it was to use as little as 16 pounds in 1873.

At this date steam jackets were common, and were used in all engines which gave the most economical performances. The steps, however, that lowered the steam consumption of compound engines from 16 pounds to 14 pounds per indicated horse-power per hour were largely the introduction of a cut-off on the low-pressure cylinder and a reheating receiver between the cylinders.

These features appear to have been the principal means of lowering economy to 14 pounds of steam; but to what are we to attribute the step to 13 pounds? Clearance is well known to be an important factor, and its reduction, especially in the last cylinder of a series, is important for economy. It is receiving constant attention from careful designers, and its reduction is a constant source of gain.

The 13-pound mark has also been reached by an increase in steam pressure, with resulting increase in the number of expansions. In some cases a reduction in the size of the high-pressure cylinder has doubtless contributed toward economy, by means of which smaller surfaces are exposed to the boiler steam than would otherwise be the case. This carries with it a proportional reduction of initial condensation in the cylinder, which is most prolific in this cause of waste.

Still further, the 13-pound mark has in general been attained by engines which have a low-pressure cylinder larger for the work to be done than is commonly the case, so that the mean effective pressure referred to the low-pressure cylinder is in the vicinity of 21 pounds.

There is a strong tendency nowadays to underrate steam jackets, but I believe that in every case where they have been wasteful, or where their economy is indifferent, at all events with ordinary speeds, an examination would show that the jackets are air-bound, water-logged, blowing through traps, or that the jacket piping is bare, and thus steam for heating the building is charged to the engine. Such an arrangement of pipes can furnish but indifferent material for giving up latent heat to the working fluid within the cylinders, and is, in fact, absurd.

The effect of reheaters in drying out steam which issues from a preceding cylinder and in superheating it to 60 degrees or 90 degrees, as is often the case, for use in the next cylinder, cannot be otherwise than advantageous, for, as Professor Thurston shows in his paper of 1894 before this Society, heat so added to the working fluid saves much more steam than was condensed to liberate this heat.

Considering economies effected, it is safe to say that, without including triple-expansion engines, steam economy has steadily decreased from 20 to 12½ pounds per indicated horse-power between 1870 and 1897. This corresponds to a saving of  $\frac{20 - 12\frac{1}{2}}{20} = \frac{7}{8} = 87\frac{1}{2}$  per cent.

The horizontal return tubular boiler is still the standard of the country, and will probably so remain. It is cheap, and if properly built it is safe.

There is scarcely any improvement to be noted in the horizontal return tubular boiler during the last 27 years as far as economy is concerned, but I believe that grates have been improved to a measurable extent, resulting in an economy of perhaps 2 per cent.

My own experience teaches me that the internally fired boiler, either of the locomotive or vertical type, will save under equal conditions some 7 per cent. of coal compared with the horizontal return tubular boiler, besides causing an important economy in doing away with brickwork.

Mr. Bryan Donkin, in a recent paper before the Institution of Civil Engineers, in discussing boiler economies, says: "Generally speaking, internally fired boilers give a higher efficiency than those externally fired. The old and well-known locomotive type, with smoke tubes and induced draft, stands high as a very economical steam generator." Such praise from so careful an investigator as Mr. Donkin should carry great weight.

Within 27 years economizers for heating feed water in smoke flues have become common. Although subject to a rather large depreciation, in the general case they will save about seven or eight per cent. of coal.

There are economies to be obtained from the use of vertical engines. These come from reduction of friction, reduction of repairs to cylinders and pistons, and diminished cylinder oil consumption. It would not surprise me if there were a net saving of five per cent. by reduced friction of a vertical compound compared with a horizontal engine.

Summing up the various items that have been mentioned, the following may be presented as the economies of the period from 1870 to 1897:

Saving due to compounding, jackets, reheaters, higher pressures and greater expansions.....	37 per cent.
Due to vertical engines.....	5 " "
Due to vertical internally fired boilers.....	7 " "
Due to economizers.....	7 " "
Due to improved grates.....	3 " "

It seems probable that the relative economies of the compound engine, using 160 pounds, and the triple, using 185 pounds of steam, are to day represented in the very best practice by 12½ pounds of steam and 11½ pounds of steam respectively per indicated horse-power per hour. This corresponds to a saving of  $\frac{12\frac{1}{2} - 11\frac{1}{2}}{12\frac{1}{2}} = \frac{1}{12} = 8\frac{1}{8}$  per cent., which is a paying saving.

The future, so far as we can now see, offers us highly superheated steam for further means of economy. The technical papers have frequent accounts of the use of such steam in Germany, and

published tests (see *Engineering*, pages 113, 391, 1895, show that a small Schmidt "motor" has used 10.17 pounds of steam per indicated horse-power per hour. It would seem that we have a right to anticipate in the early future a steam rate of 10 pounds by means of superheated steam in the best designed engines. Compared with the lowest rate thus far mentioned, this corresponds to

$11\frac{1}{4} - 10 = 11.11$  per cent.

We have also in anticipation the use of very high steam pressure and quadruple-expansion engines as built experimentally at Cornell University and described by Professor Thurston last year before this Society. If, however, steam can be so highly superheated that expansion in one cylinder will not cause condensation, nor even the saturated condition until the time of exhaust, as was the case in the Schmidt motor, extreme economy may be obtained without resort to the multiple expansion engine.

The economies thus far mentioned relate to improvements in engines and boilers; but one of the greatest economies results from the low cost of coal at present in Lowell, Lawrence and similarly located towns.

The prices of coal in these places every five years were as follows:

Year.	Price.	Kind of coal
1870.....	\$7.10.....	Anthracite
1875.....	7.20.....	"
1880.....	4.75.....	Bituminous
1885.....	4.25.....	"
1890.....	4.65.....	"
1895.....	3.85.....	"

These prices show a saving from 1870 to 1895 by themselves of about 46 per cent.

The very best steam plant of 1,000 horse-power in most mill towns in the State of Massachusetts away from tidewater 27 years ago, including a pair of simple condensing engines using 20 pounds of steam, boilers evaporating eight pounds of water on total coal used, buildings, chimney and all accessories, cost \$70 an indicated horse-power.

The very best plant of 1,000 horse-power can be installed to-day complete, including buildings, chimney, compound engine using 12.5 pounds of steam, boilers evaporating 9 pounds of water on total coal used, economizers, and all accessories, for \$57 per indicated horse-power.

Such a plant can run on 1.4 pounds of coal per indicated horse-power per hour for total coal consumed.

The saving by using a feed water heater in connection with a vertical cross-compound engine of about 1,000 horse-power at the Atlantic Cotton Mill, Lawrence, Mass., was given as follows:

A feed-water heater was placed in the low-pressure exhaust pipe near the low-pressure cylinder, and the temperatures of the water as it entered and left were taken. The average increase in feed-water temperature caused by the heater for the two days is  $65\frac{1}{2}$  degrees, which under the present conditions of temperature and steam pressure is equivalent to a saving in coal of 5.6 per cent.

The following table gives the rate of heat transfer from the steam to the water:

	First Trial.	Second Trial.
Temperature of water before entering heater.....	31 deg.	32 deg.
" after leaving.....	94 "	101 "
Increase in temperature of water.....	63 "	69 "
Average temperature of water in heater.....	63 "	66.5 "
Absolute pressure in low-pressure exhaust pipe.....	0.87 lbs.	1.36 lbs.
Corresponding temperatures exhaust pipe.....	99 deg.	111 deg.
Average difference of temperature between steam and water.....	36 deg.	44.5 deg.
Feed water used per hour.....	11,167 lbs.	13,731 lbs.
Heating surface of heater in contact with steam.....	234 sq. ft.	234 sq. ft.
Amount of heat transferred per hour, B. T. U. ....	692,354	947,439
Heat transferred per degree of average difference in temperature per square foot of heating surface per hour, B. T. U. ....	82	91

#### A Sample of Railroad Air Taken by a Chicago Commuter

He drifted into the office, looked about him curiously, walked over to the desk in the far corner, put a package down on it, and said to the man who was writing there:

"Lift it."

"Lift what?" returned the man at the desk.

"That," said the stranger, pointing to the package.

The man at the desk lifted it with an effort.

"Heavy, isn't it!" asked the stranger.

"I should say so," replied the man at the desk. "What is it?"

"That's what I came in to explain to you," said the stranger, as he drew up a chair and carefully settled himself in it. "You see, winter's coming on."

"So I've heard," returned the man at the desk.

"With winter comes cold weather. I suppose you've heard that too."

"I have."

"And in cold weather," persisted the stranger, "they shut every door and every window on every suburban train running out of Chicago, and before you get fairly out of the station, during the rush hours, when everything is crowded, you have a sick headache; three minutes later your appetite for dinner is gone, and by the

time the train has gone five miles you can feel typhoid fever coming on. Am I right?"

"You are right, but, but—"

"You instinctively recall all the articles you ever read about the value of ventilation—indeed, the absolute necessity of it to maintain health," interrupted the stranger, "and you wonder why no one else ever read any of those articles. Am I right again?"

"You are right again," answered the man at the desk, "but what has all this got to do with the weight of that package?"

"That's a sample of it," replied the stranger.

"A sample of what?"

"A sample of the air in a suburban car during the rush hour on a cold, muggy day last week. I chipped it off to bring up to you just to illustrate my remarks. And, say?"

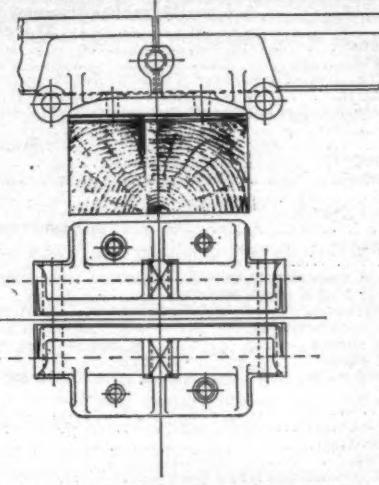
"Well?"

"I tried to bring you a piece from the smoking-car, but after I had chipped it off I found it too heavy to carry."

Then he made a quick retreat, leaving his package, and as a result the Health Department had to be requested to fumigate the room.—*Chicago Post*.

#### Webb's Rail Joint, London & Northwestern Railway.

Through the courtesy of Mr. F. W. Webb, Chief Mechanical Engineer of the London & North Western Railway, we are enabled to present an engraving of the newly patented rail joint designed by him and used on that road. The drawing shows a joint as



Webb's Rail Joint.

arranged for a heavy section of "T" rail, and it is noticeable that the design does not make use of bolts through the rail webs.

In the investigations which resulted in the design shown joints of lead were made and loaded by heavy locomotives in order to show the effect of loading joints that were not properly supported, as by the failure of the ballast in wet or improperly tamped track. The deflection of the lead joints gave the information which led to this form.

The splice is made of two castings, which are fitted to the base and web of the rail and also to the underside of the head. The castings form a base for the flange and are drawn together by the two end bolts and by the bolt at the center of the splice. This last-mentioned bolt passes through a hole formed half in each rail end.

It was stated by Mr. Webb in a paper read before the Institution of Civil Engineers, at the Engineering Conference a short time ago, that 95 per cent. of the rail failures on the London & North Western Railway occurred through the bolt holes and the cause was believed to be that in case of a badly tamped track either the fishplate must bend or the rail must tend to tear through the bolt holes. The form of joint devised by Mr. Webb has been adapted to the bullhead type of rail as well as to the form shown.

#### The New Heilmann Electric Locomotive.

The "New" Heilmann locomotive is not particularly new at this time to some of our readers, but inasmuch as several inquiries have recently been received as to the status of that com-

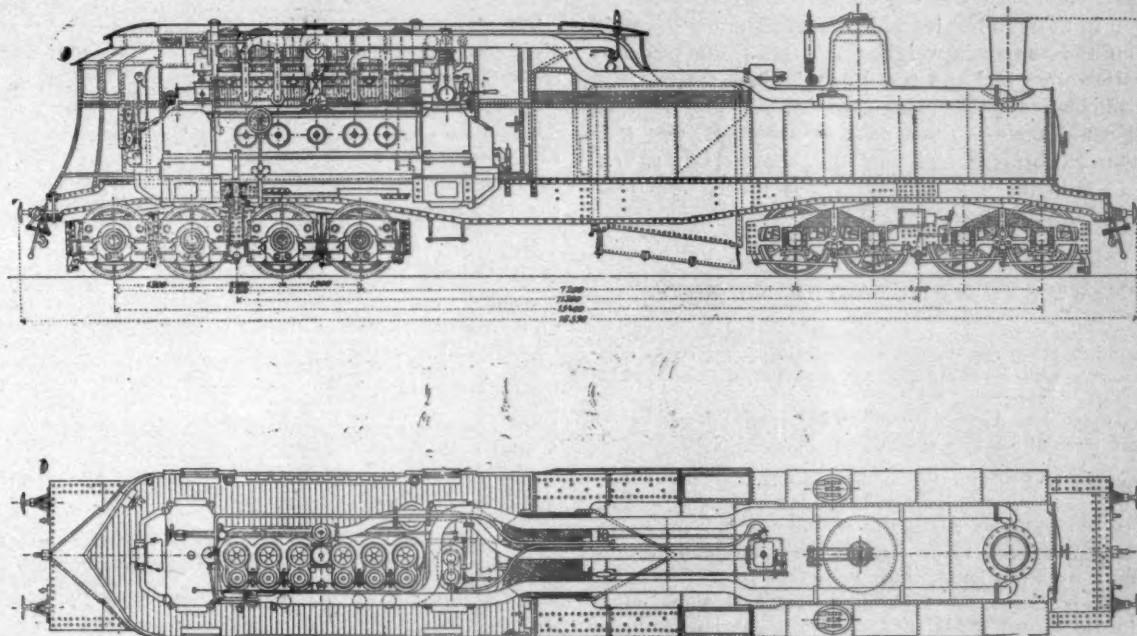
bination of stationary power plant and electric locomotive and because of recent tests of the engine we supplement the information given in *The National Car and Locomotive Builder* of June, 1895, as follows:

The old locomotive designed by Mr. J. J. Heilmann gave results which were perhaps more interesting than useful. It suggested to those who have designed and manufactured it that various improvements could be made in the structure and arrangement of the locomotive. Mr. F. Drouin, in describing in *L'Electricien* the new locomotive, briefly summarizes the leading characteristics of the older combination, for the translation of which we are indebted to *The Railway Engineer*. The locomotive tried in 1898 had a boiler of the Lentz type with 289 tubes. The total heating surface was 1,560 square feet, and the grate area 242 square feet, the pressure being 170 pounds per square inch. The engine was of the C. Brown horizontal compound double-acting type, developing 600 horse-power at 300 revolutions, the diameters of the high and low-pressure cylinders being 16.8 inches and 25.6 inches respectively. The dynamo was a six-pole machine, designed by Mr. C. E. L. Brown, giving 1,024 ampères at 400 volts. The diameter of the iron armature core was 47.25 inches, and the length of the core 17.5 inches. This dynamo was separately ex-

directors of the Compagnie de l'Ouest to construct two new machines of greater output and power. The designs were got out by Messrs. M. Mazen and G. Damoiseau, and embodied the following differences: (1) the substitution of an ordinary locomotive boiler for the Lentz boiler; (2) the use of more compact electrical apparatus and of generators with toothed armatures. In fact, everything tending to reduce weight was carefully considered. The double-acting engine is replaced by single-acting ones without diminishing the output per weight, but the steam-pressure is increased by one-sixth and the speed by one-third. The following details of the new locomotive will interest our readers.

**Boiler.**—The boiler, as stated above, is of the locomotive type, with a Belpaire furnace and copper firebox. The heating surface of the furnace is 178 square feet, and that of the tubes 1,820 square feet. The grate area is 36 square feet, and the working pressure 198 pounds per square inch. The feed is supplied by two Friedmann injectors.

**Engines.**—The engines are of the Willans & Robinson type, with six lines of cylinders, which arrangement gives a good balance in turning moment. In each engine the three cranks are inclined at 120 degrees to each other. The ordinary features of the



The Heilmann Electric Locomotive.

cited by a small dynamo driven independently, and required about 95 ampères at 50 volts. The motors were of the C. E. L. Brown four-pole type, series wound, with toothed armatures. The cores were 25.6 inches diameter and 15.6 inches long. The motor, when taking 128 ampères at 400 volts, gave a normal torque of 900 foot-pounds and ran at a speed of 410 revolutions per minute. There were eight of these motors. The principal dimensions of the complete locomotive were as follows:

Length between buffers.....	53 feet 6 inches
Total wheel base.....	38 feet 6 inches
Wheel base of bogie.....	13 feet 1 inch
Diameter of wheels.....	3 feet 9 $\frac{1}{4}$ inches
Breadth of frame.....	9 feet 10 inches

This first locomotive was able to give a normal effort of 2,820 pounds to the wheel, or at the speed of 68 miles per hour a pull of 2,100 pounds. It was not designed to give exceptional power, but rather to find out what the system was capable of doing. The author states that this first locomotive showed that the stability was independent of speed, and that the deteriorative effects on the permanent way was less than with a steam locomotive. The double transformation of power caused losses equal to about 15 per cent. of the indicated horse-power of the engines. In drawing a train weighing about 65 tons the consumption of coal was under 14 pounds per mile.

The results obtained from this first locomotive determined the

electric lighting engines are included, the working parts running in oil. The principal dimensions of these engines are as follows:

Indicated horse-power.....	1,350
Speed (revolutions per minute).....	400
Diameter of high-pressure cylinder.....	11.8 inches
Diameter of low-pressure cylinder.....	19 "

These engines have coupled to each extremity of their common shaft a direct-current dynamo, the armatures of which act as fly-wheels.

**Dynamics.**—Each of these dynamos is able to give 910 ampères at 450 volts. They are of the six-pole type, constructed by Messrs. Brown & Boveri. The field magnets are of cast steel. The armatures have toothed cores, and the current is collected by carbon brushes. The dynamos are cased in, except for a few openings for ventilation. The dynamos rest direct on the frame of the locomotive, and also form supports for the two ends of the engine bed-plate. They are excited by a smaller dynamo giving 140 ampères at 110 volts, but only 10.0 ampères are required for the dynamo field magnets.

**Motors.**—These are of the four-pole enclosed type with toothed armatures mounted on a hollow shaft connected with the driving axle. The axle is thus able to follow the inequalities of the road without transmitting shocks to the armature. The approximate concentricity of the axle and armature shaft is obtained by three double steel springs connected to one of the wheels. The frame

of the motor consists of four essential parts. The lower part has the two feet which fix the motor to one frame of the bogie, and carries also the two bearings in which the hollow shafts revolve. These bearings are automatically lubricated. The two horizontal cores carrying the series exciting coils form the next two parts, and the upper piece completes the structure. The exciting conductor is formed of copper tape wound in two sections.

**Controlling Gear.**—The locomotive can be worked from either of two positions, depending on which way the train is running, the over-all dimensions being as follows:

Length between buffers.....	50 feet 7 inches
Total wheel base.....	50 feet 6 inches
Wheel base of bogie.....	13 feet 5½ inches
Diameter of wheel.....	3 feet 9¾ inches

The first of these locomotives was subjected to a preliminary trial in January last, but no trial of speed was made. As reliable figures are likely to be obtained shortly we refrain from giving our readers calculated figures only. The designers expect to get a full load efficiency of 73.4 per cent.—that is, 73.4 per cent. of the indicated horse-power of the engines is expected to be available on the axles. The locomotive without tender weighs about 120 tons. The accompanying engravings are reproduced from *Glasers Annalen*.

A run was made with the engine November 12 from St. Lazare Station in Paris to Nantes and return. The speed was 18 miles per hour and the train weighed 150 tons. The trial was considered satisfactory and the speed was limited very strictly by the railroad company. The length of the machine was so great that it could not be turned on the turntables, and it is understood that its cost is so high that the promoters do not expect to sell to railroads, but the locomotives are to be offered for hire upon favorable terms.

#### EQUIPMENT AND MANUFACTURING NOTES.

The Richmond Locomotive Works are building five freight locomotives for the Wabash.

The Pennsylvania has decided to build 15 consolidation engines for the western lines at Juniata shops.

The Schenectady Locomotive Works have orders for two switching engines for the Union Stock Yards Transit Company, of Chicago, two more 20 by 26-inch consolidation engines for the Grand Trunk, one fast passenger engine for the New England for the New York and Boston five-hour train, 10 mogul 20 by 28-inch engines for the New York, New Haven & Hartford, eight mogul locomotives for the Boston & Maine, and several freight and passenger locomotives, the exact number not known, for the Northern Pacific.

The Dickson Locomotive Works have orders for five 21 by 28 inch consolidation locomotives for the Atchison, Topeka & Santa Fe Railway and for two 6-wheel switching locomotives, to go to the Sanyo Railroad, Japan.

The Brooks Locomotive Works will build for the following roads: Pittsburgh, Bessemer & Lake Erie, two locomotives; C. C., C. & St. L. Railway, six switching locomotives; Reynoldsville & Falls Creek one 19 by 24-inch mogul and for the Wisconsin Central six 10-wheel freight and four 10-wheel passenger locomotives.

Locomotives have been ordered from the Pittsburgh Locomotive Works by the following roads: the Louisville, Henderson & St. Louis, two locomotives; Pittsburgh, Bessemer & Lake Erie, four locomotives; the Wabash, five freight locomotives; the Arkansas & Choctaw, one mogul locomotive.

The following orders have been taken for locomotives by the Baldwin Locomotive Works: The Evansville & Richmond, three 8-wheel engines; the Iowa Central, two 6-wheel switchers; Intercolonial of Canada, the World's Fair Baldwin exhibition locomotive; the Southern Indiana, three passenger locomotives; the Kansas City, Pittsburgh & Gulf, 15 10-wheel locomotives with 20 by 28-inch cylinders; the Wabash, one Atlantic type passenger locomotive and five freight locomotives; the St. Louis, Peoria & Northern, two 8-wheel passenger locomotives; the Kanawha & Michigan, three moguls to be built in 30 days; the Baltimore & Ohio, 10 consolidation locomotives; the Norfolk & Western, six

2-cylinder compounds; the Denver & Rio Grande, two 10-wheel freight engines.

The Cooke Locomotive Works are building a 10-wheel locomotive for the Bangor & Portland Railroad for freight service.

The Baltimore & Ohio is about to contract for 5,000 new freight cars.

The Detroit, Grand Rapids & Western has ordered 250 freight cars from the Michigan Peninsular Car Company.

The Great Northern has ordered 10 combination and 16 tourist cars from the Barney & Smith Car Company, of Dayton, O., and the Colorado & Northwestern is reported to have ordered four passenger and combination cars from the same firm.

The Canadian Pacific has contracted for 20 passenger cars with the Crossen Car Manufacturing Company, of Cobourg, Ont.

The Vandalia has ordered 100 freight cars from the Missouri Car & Foundry Company.

The Allison Manufacturing Company, of Philadelphia, has received an order for 350 freight cars for the Central Railroad of Brazil.

The Chicago Great Western has ordered 100 Rodger ballast cars of the Rodger Ballast Car Company. These will be accompanied by four plow cars or distributors.

The Chicago & West Michigan has ordered 150 cars from the Michigan Peninsular Car Company. They will have Chicago rabbeted grain doors and security lock brackets.

Pullman Palace Car Company has orders for 300 stock and 200 box cars from the Omaha, Kansas City & Eastern. This firm also secured the order for 20 combination cars for the Long Island Railroad, for 300 box cars for the Chicago Great Western, and 200 box cars for the Kansas City, Memphis & Birmingham.

The Alton Terminal Railroad is having 100 freight cars built by the Indianapolis Car & Foundry Co.

Wells & French have an order for 50 refrigerator cars for the Union Pacific, Denver & Gulf.

The Southern Indiana has ordered 150 flat, 50 coal and 25 box cars from the Barney & Smith Car Company.

The Laconia Car Co. has an order for 500 box cars from the Boston & Maine.

Five hundred freight cars will be built by the Pennsylvania at Altoona, for its Eastern lines.

The Arkansas & Choctaw has ordered 30 new logging cars, which are to have Westinghouse brakes and Trojan couplers.

The Atchison, Topeka & Santa Fe will build 250 refrigerator cars and 100 50-foot furniture cars at its own shops.

The Pullman Palace Car Company has an order from the Duluth-Missabe & Northern for 400 60,000-pound ore cars.

The Pittsburgh, Bessemer & Lake Erie has ordered 100 35-foot 60,000-pounds capacity box cars from the Ohio Falls Car Company.

The special business of the Baltimore & Ohio for Sunday, Dec. 12, amounted to 18 parties, with a total of 740 people.

The pay of the general office employees of the Missouri Pacific at St. Louis has been restored to the extent of the cut of 10 per cent. in 1893.

The boiler lagging for the new experimental locomotive at Purdue University is Messrs. Keasbay & Mattison's magnesia sectional covering. The same insulation is used on the cylinders.

The Q & C Company has just made arrangements with the National Railway Specialty Company for a license to manufacture the Rear Edge Protecting Strip, which will be called the "N. R. S. Protection Strip." It may be used with the Q & C doors.

Continuous activity is noted among manufacturers of Car Material. Some heavy orders for axles, channels, etc., have recently been placed. More inquiries for cars, says the *Iron Age*, are in the market and further business is assured in this direction.

The Baldwin Locomotive Works has an order for building 56 motor car trucks for the Metropolitan West Side Elevated Railroad of Chicago. They will be built to designs by the road and will accommodate motors of a larger capacity than those at present in use.

The Chicago Pneumatic Tool Company has received an order for two No. 2, two No. 3 and two No. 4 pneumatic hammers and one piston air drill from Mr. W. E. Dixon for the Sormovo Locomotive Works at Nijni Novgorod, Russia. This is the third order for these tools from this concern.

The Freight Car Door Fastener, manufactured by the Dayton Malleable Iron Company, of Dayton, Ohio, is having an extraordinary sale; recent orders aggregate 15,702 sets. The total sales of this device amount to over 250,000 sets, and it is said to be giving universal satisfaction.

The bid by the Bath Iron Works, of Bath, Me., for the construction of the naval practice ship was the lowest offered and it is expected that the contract will be awarded them.

Several daily papers of Dec. 20 stated that the Delaware, Lackawanna & Western had the equipment of its Morris & Essex division with electric power under consideration. We are informed in a communication from Mr. Samuel Sloan, President of the road, that the reports are untrue.

The National Electric Car Lighting Company is progressing rapidly with the equipment of cars on the Atchison, Topeka & Santa Fe Railway under the contract for lighting 50 cars with their system and we are informed that another contract has been taken recently from an Eastern road for the same system.

An excellent and gratifying condition of business in the car heating line is reported by Mr. William C. Baker. The orders continue to come in and he has been obliged to increase the factory force in order to supply the demand.

The Reading Car Wheel Company, of Reading, Pa., have been granted a charter under the laws of Pennsylvania, with a capital of \$50,000. The Directors are Messrs. Herbert H. Hewitt, President; John J. Albright and Edmund Hayes, of Buffalo, N. Y., and Chas. H. Dubock and H. W. Cram, of Reading. Mr. Hewitt and other officers of the company are also with the Union Car Works, of Depew, N. Y.

The battleship *Iowa*, the gunboat *Newport* and the torpedo boat *Foote* have been finally accepted by the Navy Department, and Secretary Long has directed that all reserves be paid to their builders, the Cramps, the Bath (Maine) Iron Works, and the Columbian Iron Works, Baltimore, respectively.

We are informed that in the specifications for the following freight cars recently ordered the Chicago Rabbeted Grain Door and the Security Lock Bracket were required; 250 cars, Illinois Central, building by the St. Charles Car Company; 1,000 cars, Illinois Central, by Haskell & Barker; 250 cars, Illinois Central, by Missouri Car and Foundry Company; 250 cars Detroit, Grand Rapids & Western, by Michigan Peninsular Car Company.

The Westinghouse Electric and Manufacturing Company has received an order for the equipment of the traction tramways of Glasgow, Scotland, with electrical machinery. This includes the car and power-house equipment. This company also has a contract for a large lighting plant for Malaga, Spain, and several for electrical machinery for Niagara Falls and Buffalo. The latter contracts amount to nearly \$1,000,000.

Messrs. R. D. Wood & Company, of Philadelphia, have furnished a 17-foot gap hydraulic riveter of 100-tons capacity and three powers for the new boiler-riveting plant of the Schenectady Locomotive Works. They have also taken orders for a similar riveter from Messrs. Neilson & Company, of Glasgow, Scotland, and one for a 12-foot gap riveter for the Brooks Locomotive Works, of Dunkirk, N. Y. The Baldwin Locomotive Works have also ordered portable hydraulic riveters of 15 and of 30-tons capacity from this firm.

Mr. D. Lee, Engineer Maintenance of Way of the Baltimore & Ohio lines west of the Ohio River, has been experimenting during the past year or two with slag for ballast. His plan is to put about 1 foot under the ties, and it makes very good ballast. About 18 miles of the Akron Division have been improved in this way, but Mr. Lee's preference is for gravel when it is available. During the past season on the Trans-Ohio Division he has put in 143 miles of new ballast, the principal part of which was good, clean gravel. In addition to the ballasting, the Trans-Ohio Division has had 480,981 new cross-ties, and there have been 31 miles of new 75-pound steel rail laid, replacing 60-pound rails.

The new sleeping cars that Pullman's Palace Car Company has placed in service within the past month on the Baltimore & Ohio Railroad between Baltimore and Louisville, Ky., are an improvement over those heretofore used on that line. They have large smoking rooms and an extra size ladies' toilet room, a feature which will be thoroughly appreciated by the fair sex who have had to use some of the Columbian cars hitherto run between those cities. The Chicago and New York service has been improved by the addition of seven new Pullman cars which the Pullman people say are the best they operate. They have large smoking rooms, large ladies' toilet rooms, empire deck and all the new features that the company has recently introduced.

The Composite Brake Shoe Company, of Boston, Mr. W. W. Whitcomb, President, has recently made arrangements with the Sessions Foundry Company, of Bristol, Conn., for the manufacture of the composite brake shoe with which our readers are familiar, and it is understood that the Sessions Foundry Company will look after the sale of this shoe in a large and important territory. The shoe is making a good name for itself and the Composite Brake Shoe Company is to be congratulated in securing the assistance of the Sessions people in its manufacture and sale. The performance of the composite shoes on the new steam motor car of the New England Railroad is referred to elsewhere in this issue. One of the stops for which the data are given was remarkable both in its smoothness and in the short space covered after the brakes were applied.

The American Pegamoid Company was incorporated at Trenton, N. J., December 17, 1897, with a capital of \$5,000,000. The incorporators are John A. McCall, J. J. Byers, A. W. Pope, G. I. Herbert, Edward H. Haskell, John J. McCook, John T. Collins, Col. Albert A. Pope, John R. Bartlett, Conrad N. Jordan, E. F. C. Young, Thos. A. McIntyre and Peter T. Bosten. The New York office of the company is at 11 Broadway. According to the prospectus of the company, the name "Pegamoid brand" is applied to articles treated by a process which consists of the application, in a liquid form, of a composition which, by impregnating the fibers or pores of the substances treated, has the effect of water-proofing, strengthening, sterilizing and generally protecting the material used. It can be applied to cloths, all kinds of paper—including wall papers; to hides or skins; and in the form of paint—to all iron, steel, wood and stone work. Articles subjected to this process are rendered stronger, more durable and useful. They are absolutely rot and damp proof, and are unaffected by changes of temperature or climate, while in many cases the cost is materially reduced.

Concerning American locomotives in China, Consul Read, of Tientsin, transmits the following to the State Department:

"I have the honor to report that the steamship *Liv* has arrived with the 12 Baldwin locomotives for the Tientsin-Lukouchiao (Peking) extension, and is discharging her cargo at the railway wharf at Tangku. A representative of the firm of Messrs. Burnham, Williams & Co., Philadelphia, the makers of these locomotives, is now in Tientsin to superintend their erection. Eight of the locomotives are very heavy and are of the 'mogul' type, and the order for them was secured by Messrs. Burnham, Williams & Co. last September, this firm having tendered at prices far below those submitted by English firms. The other four are switch engines, and were ordered outright without a call for tenders. It is a matter of great satisfaction that the new line is equipped with American locomotives. We can rest assured that Messrs. Burnham, Williams & Co. have laid down locomotives that will be, in every respect, according to specifications, and that will more than meet the expectations of the railway officials. I trust that we may, with regard to future extensions of the railway, hold the vantage-ground that is now ours. The next order for locomotives will be for the Lukouchiao-Paotingfu extension. This extension will be rapidly pushed as soon as the line to Peking has been double-tracked."

The formation of a gigantic wood-working machinery combination was announced in our December issue. We are informed that this failed on account of the Fay-Egan concern of Cincinnati. An other trust is announced as having been organized in Jersey City. The incorporation papers place the capital at \$4,000,000, divided into 40,000 shares of \$100 each; 20,000 shares are preferred stock, and they will draw interest at seven per cent, either semi-annually or annually before any dividend is declared. The incorporators named in the papers are Charles N. King, Nelson R. Vanderhoff, Samuel D. Dickinson, Robert S. Jordan and John J. Mulvaney, of

**Jersey City;** Ralph D. Parrott, of Metuchen; Charles A. Senior, Jr., and William R. Robins, of New York; George A. McGlone, of Bolivar, W. Va., and Somervall Solomon, of New York. The following statement was given out by one of the incorporators:

"This company has purchased and owns a number of the oldest and most successful concerns engaged in the manufacture of wood-working machinery. The plants are in the Eastern, Middle and Western States. They will be operated under one management. The Board of Directors include some of the most successful and able manufacturers and managers in the business. The officers of the company are: President, William Duryea, of New York; First Vice-President, A. D. Hermance, of Williamsport, Pa.; Second Vice-President, Henry C. Baker, of Philadelphia; Treasurer, R. W. Perkins, of Norwich, Conn.; Secretary, Frank W. Duryea, of New York City. It is stated that a storehouse will be built in Jersey City as soon as a site can be secured. The company announces that it intends to thoroughly exploit the foreign field."

Cable orders were received by the Chicago Pneumatic Tool Company for 56 of their machines during the month of October, and the foreign business of the company is developing so rapidly as to necessitate additions to the capacity of the works in order to keep up with the demand. The orders have continued to come in from abroad so rapidly as to make the foreign work a very important branch of the business and the progress made in England and on the Continent is shown in a partial list of concerns now using pneumatic hammers and piston air drills furnished by this company, which comprises 16 prominent railroads and 60 widely known firms of engineers and shipbuilders. Through the courtesy of Mr. John W. Duntley, our representative, was allowed to read this list, and we would recommend any who entertain doubts as to the efficiency of the machines to examine the list, than which no stronger proof of their eager reception in Europe could be asked. Among letters from users of the tools in the United States our representative was permitted to see two that are specially good, from the Wm. Cramp & Sons Ship and Engine Building Company, of Philadelphia; and from the Bigelow Company, of New Haven, Conn. Pneumatic tools have apparently taken the shipbuilders by storm; they fit in specially well in operations that were formerly done at great expense by hand. These concerns cannot afford to fool with appliances that will not stand up to the work and the advent of air tools into heavy work, both marine and otherwise, seems likely to show the same economic effects as followed their introduction into railroad work. This firm has recently perfected an improved pneumatic machine for rolling and expanding flues, driving boring bars and furnishing power for similar operations about engines and boilers. The machine will be illustrated and described in a future issue of this journal, meanwhile it is sufficient to say that it consists of two 2 by 3 inch oscillating cylinders for the power and a feed cylinder with 12-inch stroke. It will cut, roll and expand flues at a rapid rate, saving, it is said, about 72 hours over hand work per locomotive boiler. Two hundred and fifty flues have been cut in one hour and 250 have been expanded in three hours. The advantage of cutting the flues close to the sheet is an important one, the cut being as close as  $\frac{1}{4}$  inch from the sheet when desired. This is a powerful machine and yet it is light enough to be easily transported and used.

## Our Directory

### OF OFFICIAL CHANGES IN DECEMBER.

**Baltimore & Ohio.**—Mr. John K. Cowen was re-elected President at a recent meeting of the Board.

**Boston Elevated.**—Mr. J. A. L. Weddell, M. Am. Soc. C. E., of Kansas City, Mo., has been appointed Consulting Engineer, and Mr. George A. Kimball, M. Am. Soc. C. E., Exchange Building, Boston, has been appointed Chief Engineer.

**Boise, Nampa & Owyhee.**—Mr. John E. Stearns has resigned as General Manager.

**Carabella, Tallahassee & Georgia.**—Mr. W. A. Simmons has been elected President.

**Central of Georgia.**—Mr. W. H. Stulb, Master Mechanic at Augusta, Ga., has been appointed Master Mechanic at Macon, Ga., to succeed Mr. John Dempsey, resigned. Mr. J. H. McCann is appointed Master Mechanic at Augusta.

**Chicago & Southeastern.**—Mr. A. C. Campbell, of St. Louis, Mo., has been appointed Receiver by the Supreme Court. He will move the offices from Anderson, Ind., to Brazil, Ind.

**Cincinnati, Hamilton & Dayton.**—Mr. A. D. McCallum has been appointed Master Mechanic at Hamilton, O.

**Columbus, Sandusky & Hocking.**—Mr. T. M. Downing has been appointed Master Mechanic, with headquarters at Columbus, O.

**Danville & Mount Morris.**—Mr. M. F. Lapp, Purchasing Agent and Acting Superintendent, with headquarters at Danville, N. Y., has been appointed Superintendent, with headquarters at the same place, succeeding B. F. Humphrey, resigned.

**Duluth, South Shore & Atlantic.**—Mr. J. J. Conolly has been given the title of Superintendent of Motive Power and Machinery. He was formerly Master Mechanic of this road.

**Ferro-Carril Central.**—Mr. Alberto Villasenor has been appointed Master Mechanic, with office at Salvador, C. A.

**Florida Central & Peninsular.**—Capt. D. E. Maxwell has been elected Vice-President, retaining also the position of General Manager.

**Fitchburg.**—After Dec. 1 the headquarters of Mr. J. Medway, Superintendent of Motive Power, now at Boston, Mass., will be located at Keene, N. H.

**Fonda, Johnstown & Gloversville.**—Mr. P. E. Garrison has been appointed Master Mechanic, with headquarters at Gloversville, N. Y.

**Georgia.**—Mr. C. H. Phinzy has resigned as President, and is succeeded by Mr. J. Phinzy, and Mr. L. Phinzy, a brother of the new President, was chosen Vice-President.

**Georgia & Alabama.**—The office of Mr. Cecil Gabbett, Vice-President and General Manager, has been removed from Americus to Savannah, Ga.

**Intercolonial.**—Mr. C. R. Palmer has been appointed Purchasing Agent, vice Mr. Thos. V. Cooke, resigned.

**Maine Central.**—Mr. George F. Evans was chosen Vice-President at a recent meeting of the Board of Directors. He is also General Manager.

**Mexico, Cuernavaca & Pacific.**—Mr. J. A. Chisholm has been appointed Chief Engineer, with headquarters at the City of Mexico, vice Mr. H. H. Filley, resigned.

**Mexican National.**—Mr. W. F. Galbraith, Master Mechanic, has changed his headquarters to Santiago, Mex.

**Mississippi River & Bonne Terre.**—Mr. J. Burns has resigned as General Superintendent.

**Missouri, Kansas & Texas.**—After Jan. 1 this road will be operated from the Texas offices, in Dallas, Tex., to which point Vice-President and General Manager A. Allen will move his office, now at St. Louis, Mo.

**New Orleans & Northwestern.**—Mr. Louis K. Hyde, Receiver for the company, has been elected Vice-President, and Mr. Frank DeLancey Hyde, formerly First Vice-President, has been elected Second Vice-President.

**New York & Ottawa.**—Mr. E. La Lime has resigned as Superintendent and Master Mechanic, and taken the position of Master Mechanic of the Ohio River Railroad.

**Oregon Improvement Company.**—Mr. C. J. Smith, Receiver, has been made General Manager of the Pacific Coast Company, under which name a reorganization of the Oregon Improvement lines has been effected.

**Oregon Railroad & Navigation Company.**—Col. William Crooks has been appointed Chief Engineer. He was formerly Chief Engineer of the Minneapolis & St. Louis.

**Ohio River.**—Mr. W. W. Layman has resigned as Master Mechanic and is succeeded by Mr. E. La Lime.

**Omaha, Kansas City & Eastern.**—Mr. Ira C. Hubbell has been appointed Purchasing Agent. He holds the same position on the Kansas City, Pittsburgh & Gulf and the Omaha & St. Louis Railroad. Mr. John M. Savin has been appointed Assistant General Manager and General Superintendent, with headquarters at Quincy, Ill.

**Pecos Valley.**—Mr. C. M. Stansbury has been appointed Master Mechanic, with headquarters at Eddy, N. Mex., to succeed Mr. G. F. Miller.

**Pittsburgh, Bessemer & Lake Erie.**—Mr. H. T. Porter has been appointed Chief Engineer, with headquarters at Pittsburgh, Pa., succeeding Mr. Francis E. House, promoted.

**San Francisco & San Joaquin.**—Mr. W. B. Storey has been appointed Chief Engineer, with headquarters at San Francisco, Cal.

**Salt Lake & Ogden.**—Mr. W. T. Godfrey has been appointed Master Mechanic, with headquarters at Salt Lake City, Utah. He is to succeed Mr. John Hurst, deceased.

**Southern Indiana.**—Mr. Alexander Shields has been appointed Master Mechanic, with headquarters at Bedford, Ind.

**Sandusky & Hocking.**—Mr. F. P. Boatman has resigned as Master Mechanic.

**Southern Pacific.**—Gen. Thomas H. Hubbard, Second Vice-President of this company, was chosen First Vice-President, to fill the vacancy caused by the death of Charles F. Crocker. Mr. George Crocker was chosen Second Vice-President, to succeed Gen. Thomas H. Hubbard.

**Texas Midland.**—Mr. U. R. Smithine has been appointed Master Mechanic, to succeed Mr. B. R. Hanson.

**Wagner Palace Car Company.**—Mr. J. A. Spoor, General Manager, has been chosen President of the new company formed by a consolidation of the Union Stock Yards and Transit Company and the Chicago, Hammond & Western Railroad.

**Waynesburg & Washington.**—Mr. Joseph Wood has been elected President.